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Economic Evaluation of Pasture and Dry-Lot Feeding for Dairy Cattle

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Dairy farming has been characterized by relatively constant price levels for milk and milk products. Many farmers in the past entered dairying to obtain more stable incomes and incomes that were spread throughout the year rather than those occurring seasonally. Higher production levels of animals, improved feeds, and labor-saving technologies have all aided in raising productivity but many dairy farmers still face declining incomes as cost rises more than offset the gains. Dry-lot feeding of roughages instead of pasturing is one technique being used by some dairy farmers in response to these conditions.

According to the dairy husbandry personnel consulted, farmers can be expected to tend toward dry-lot feeding of dairy cattle. "Dry-lot feeding" refers to the confining of cows that are producing milk, freeing pasture land for more intensive crop uses. At present, many dairy farmers allow their cattle to graze. This lowers the percentage output of roughages. Due to rising land costs, this practice may be becoming economically unfeasible. To investigate the benefits from dry-lot feeding of dairy cattle relative to present practices, economic comparisons should be made between systems that allow dry-lot feeding or pasture feeding of dairy cows.

This publication reports on such a study based on dairy farming in Franklin County, Mo. The area is in the eastern part of Missouri near St. Louis. Dairy farmers in this area have certain problems in obtaining resources. Urbanization trends have caused increased competition for land and labor and, therefore, rising resource prices which can be expected to intensify in the future. For this study all Grade A Milk producers in Franklin County were identified and a survey of them was taken in the fall of 1964 to determine economic and sociological characteristics. Of the 90 Grade A producers in the county, 86 were interviewed and the information obtained from them was used in formulating the models.

Objectives

There are innumerable factors affecting a farmer's decision-making process; he must be cognizant of many factors, measurable and nonmeasurable, that restrict as well as aid his actions during the production period. The dairy farm operator must consider various crop enterprises, supplemental livestock enterprises, price levels of resources and products, etc., to come up with the resource mix and product mix that will best satisfy his objectives. The general purpose of this study is to examine the profitability of year round feeding of roughages in dry-lots in contrast to the present practice of allowing the cattle to graze for about half of the year.

The specific objectives of the study are:

1. To determine the quantities and combinations of resources and the specific crop and livestock enterprises which will result in maximal levels of income for dairy farmers with specified labor resources, land resource mixes, and, particularly, pasturing practices.
2. To determine the effects of varying levels of various resources on net returns.

Methodology

Linear programming was used in the study to determine the optimal combinations of resources subject to labor restrictions, land resource mixes, and pasturing practices that would maximize profit levels. Linear programming is a procedure for the solution of problems in which a linear function of a number of variables is to be maximized or minimized when the variables are subject to restraints in the form of linear equalities or inequalities.[1] The linear programming results are subjected to additional analyses, including some capital budgeting procedures, to further evaluate their profitability.

Study Area

The study area of Franklin County, Mo. is located approximately 30 miles west of St. Louis on highways Interstate 70 and U.S. 40. Franklin County soils may be broken into two major soil areas or districts (Figure 1). These two, designated as Areas 1 and 2, are used for the land resource bases.

Soils of Area 1 are primarily of the Menfro-Winfield-Weldon Soil Association and are light colored, formerly forested soils positioned on the narrow ridgetops and steep slopes of the river hill areas bordering the Missouri River.[2] The soils are in bands parallel to the river bluff line with Menfro soils lying on the

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[1] See: Kenneth E. Boulding and W. Allen Spivey, *Linear Programming and Theory of the Firm* (The MacMillan Company, New York, New York, 1961); Robert Dorfman, Paul A. Samuelson, and Robert M. Solow, *Linear Programming and Economic Analysis* (McGraw-Hill Company, New York, New York, 1958); Saul I. Gass, *Linear Programming Methods and Applications* (McGraw-Hill Book Company, New York, New York, 1964); T. C. Koopmans, *Activity Analysis of Production and Allocation* (John Wiley and Sons, Inc., New York, New York, 1951).

[2] C. L. Scrivner, J. C. Baker, and B. J. Miller, *Soils of Missouri: A Guide to Their Identification and Interpretation* (University of Missouri Extension Circular C-823, October, 1966), p. 17.

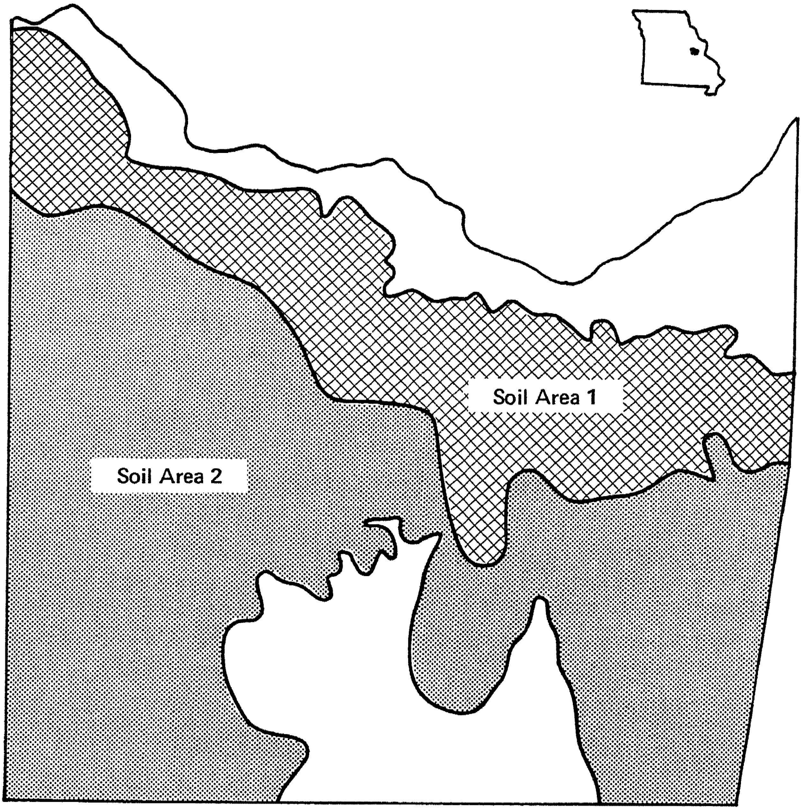

Figure 1. Areas of Franklin County.

bluffs with the steepest slopes, Winfield soils positioned farther from the river bluffs, and the Weldon soils on rolling topography farther from the river.

The dominant soil association in Area 2 is the Union-Fullerton-McGirk Association, found on rolling to steep topography bordering streams. These soils are light brown in an area which was originally forested. Union soils are the most extensive in this association and are found on the steep upper slopes while the Fullerton soils are located on the steep lower slopes. The McGirk soils are found in the foot slopes and other low seepy areas. In the southwest part of Area 2, the Lebanon-Nixa-Clarksville Association is found. It occupies a nearly level to gently rolling topography interrupted by steeply sloping areas bordering drainages and streams. The Lebanon soils are on ridgelines, Nixa soils are on more sloping topography, and the Clarksville soils are on the steepest slopes.

Soils of Area 2 are of lower inherent fertility and lower productivity. They present greater erosion and soil maintenance problems than do soils of Area 1. The soils are primarily suited for use as pasture land or timberland. The topography is similar to that of Area 1 but the nearly level regions of Area 2 have very low fertility levels whereas the more level regions of Area 1 have greater fertility. In Area 2, there is a relative scarcity of land suitable for cropland.

Model Formulation

The description of the linear programming models for Areas 1 and 2 encases the following items for each area: (1) the resource situations, (2) the admissable crop and livestock activities, and (3) the crop and livestock budgets.

Resource Situations for Area 1

The land use patterns assumed for Area 1 were derived from those of the 54 farms where interviews were taken in that area. Table 1 shows the average

TABLE 1 - REPRESENTATIVE LAND MIX FOR AREA 1, FRANKLIN COUNTY WITH LAND USES AND RESPECTIVE PERCENTAGES (ACRES)

Land Use			Percentage of Total
Cropland			
Bottomland	28.1		11.84
Upland Cropland	121.0		50.97
Total Cropland		149.1	62.81
Non Cropland			
Woods and Wastes	58.6		24.68
Total Permanent Pasture	29.7		12.51
Total Non Cropland		88.3	37.19
Total Acreage		237.4	100.00

acreages in various land uses as practiced by these farmers in 1963. The average size of dairy farm totaled 237.4 acres with 149.1 acres of cropland and 88.3 acres of land unsuitable for cropping. The majority of the farmers indicated that they had 50 percent or more of their upland cropland terraced. As might be expected, upland cropland that is terraced can be cropped more intensively than unterraced land but only in the face of higher costs. The postulated maximum use intensities were: (1) bottomland can be cropped as continuous row crops, (2) terraced upland cropland can be cropped in a rotation of two years of row crops, one year small grain, and one year of meadow, and (3) unterraced upland cropland can be cropped in a rotation of two years row crops, one year small grain, and three years of meadow. In the model, land purchase activities were set up that allowed the purchase of a mixture that included terraced upland cropland or upland cropland in unterraced form. The purchase had to have designated proportions of the different types of land where more than one type of land was in the model, i.e., according to the proportions as presented in Table 1. The model was formulated so that the amount of land used (purchased) in the optimal solution was determined by the program. As such, the program could leave land idle in the final solution. Stipulation of a definite land mix pattern requires purchase of nonproductive as well as productive lands.

Land values were estimated by persons familiar with farm real estate prices in the area (Table 2). The land value per acre is $225 for unterraced upland cropland but $250 per acre for terraced upland cropland; these values are for an acre proportioned according to previous stipulations. The $25 differential per acre

TABLE 2 - ASSUMED LAND VALUES AND ALLOCATED OVERHEAD COSTS FOR AREAS 1 AND 2, NONTERRACED AND TERRACED LAND, FRANKLIN COUNTY (DOLLARS)

		Area 1		Area 2
Item	Unit	Nonterraced	Terraced	Acreage
Land Value	Acre	225.00	250.00	150.00
Interest[a]	Acre	12.38	13.75	8.25
Tax[b]	Acre	2.25	2.50	1.50
Total Allocated Overhead Land Cost	Acre	14.63	16.25	9.75

[a]Calculated at 5.5% per year.

[b]Calculated at $1 for $100 evaluation (full value).

between the land patterns reflects the costs of terracing the upland cropland. The total allocated overhead cost per acre is $14.63 and $16.25 for the respective terracing practices.[3]

The total amount and distribution of labor use is determined by the program. However, three labor levels were assumed on the basis of data provided by the interviewed farmers. Labor level 1 corresponds to an operator doing all the work but able to hire hourly seasonal labor as needed; labor level 2 corresponds to a two-man operation, the operator and a full-time laborer, with access to seasonal labor; and labor level 3 corresponds to a two-man partnership with a fulltime laborer and access to seasonal labor. The distribution of the available hours is shown in Table 3. The cost of the full-time laborer is assumed to be $3600 per year and hourly seasonal labor is $1.35 per hour. These levels may seem high, but Franklin County dairy farmers must pay wages that are competitive with nearby urban offerings.

TABLE 3 - POSTULATED LABOR SUPPLIES FOR DAIRY FARMERS IN FRANKLIN COUNTY: 1970-75 (HOURS)

Month	Seasonal Labor	Labor Level 1	Labor Level 2	Labor Level 3
January		250	500	750
February		250	500	750
March		250	500	750
April		250	500	750
May	180	260	520	780
June	200	260	520	780
July	200	260	520	780
August	200	260	520	780
September	200	260	520	780
October		250	500	750
November		250	500	750
December		250	500	750
Totals	980	3050	6100	9150

Information provided by the sample data indicates that the limiting factor with respect to obtaining capital funds is the farmer's aversion to risk, not an actual limitation of funds *per se.* On the basis of this information, linear programming models developed in this analysis assume that capital availability is unlimited. The interest rate charged for real estate purchases is assumed to be 5.5 percent while the interest charge for equipment, livestock, and operating capital

[3]The taxing rate is postulated to increase to $1.00 per $100 of full value during 1970-1975. See United States Department of Agriculture, Economic Research Service, *Farm Real Estate Taxes: Recent Trends and Developments* Washington, Government Printing Office, October, 1964), p. 12.

is assumed to be 6 percent; higher rates for these purposes are valid due to the shorter life of these assets.

The normative level of management is that presently demonstrated by the top 10 percent of the farmers in the area. The quality of decision-making will have to improve if the farms are to remain competitive with other enterprises. Managerial innovations are assumed to be adopted as they occur.

Under the assumptions of the study, technological advances now known but not widely used will be adopted as will future innovations in production practices. Crop and livestock production levels will be based on utilization of a machinery level that includes a three-plow tractor and a complement of similarly sized field equipment. Machinery innovations expected in the field of dairying are devices to reduce the work load of operators; in cropping activities, they will be primarily changes that lower production costs.

Sample data indicate that 56.5 acres or 23.8 percent of the total acres of the average farm were rented. While rental arrangements will, of course, still be present, the ownership form assumed for the study is an owner-operator arrangement.

Resource Situations for Area 2

As is the case for Area 1, the land use patterns for Area 2 were derived from the average values currently (1963) used in the area. Table 4 shows the land mix that is assumed to be representative of farms located therein. The size of the average farm totals 337 acres with 176.4 acres of cropland and 107.4 acres of land in woods and wasteland. A majority of the farmers had less than 50 percent of their upland cropland terraced. It therefore was assumed in this analysis that the

TABLE 4 - REPRESENTATIVE LAND MIX FOR AREA 2, FRANKLIN COUNTY, WITH LAND USES AND RESPECTIVE PERCENTAGES

Land Use	Acres	Percentage of Total
Cropland		
Bottomland	40.1	11.90
Upland Cropland	136.3	40.44
Total Cropland	176.4	52.34
Non Cropland		
Woods and Wastes	107.4	31.87
Total Permanent Pasture	53.2	15.79
Total Non Cropland	160.6	47.66
Total Acreage	337.0	100.00

upland cropland would be unterraced; comparison of program solutions for Areas 1 and 2 were expected to demonstrate the feasibility of additional investments for terracing upland cropland in Area 2.

The maximum cropping intensity assumptions for Area 2 are that bottomland can be planted in continuous row crops while the upland cropland can be cropped in a rotation of one year row crop, one year small grain, and four years meadow. The premise regarding permanent pasture land in both Areas 1 and 2 is that the land will remain in pasture.

Crop yields were determined separately for each type of land and will be presented in a later section on crops. The land value assumed for the representative land mix of Area 2 is $150 per acre. The total allocated overhead land cost is $9.75 per acre. The value of land is lower in Area 2 than in Area 1 due to the larger proportion of lower quality land in the area, with the land primarily suitable for pasture land.

Other resources are treated in the same manner as described for Area 1.

Admissable Alternatives

The livestock and cropping activities allowed in the linear programming models for Areas 1 and 2 are consistent with the practices most frequently followed by farmers in Franklin County. These activities include those for which there is a sufficient or anticipated market to permit them to be considered by all farmers as adjustment opportunities. The cropping activities are those that satisfy erosion control demands and land use intensities for the respective areas, with positive over-all contributions to the business enterprise. The primary assumption made with respect to livestock activities is that present dairy farmers will continue to emphasize dairying, but the program is constructed so that the most profitable livestock alternatives will be selected.

To investigate the economic feasibility of confinement feeding of dairy cattle as compared to present practices, models were developed that maximized the net returns to objective functions representative of roughage alternatives. The first objective function represented the situation where the program determined the optimal resource mix when pasturing and dry-lot feeding of dairy cattle were simultaneously considered as production alternatives. The second objective function represented the situation where the program determined the optimal resource mix when only pasture feeding was the permissable forage system. The third objective function allowed dry-lot feeding of dairy cattle as the only permissable forage technique. The profits from the cropping activities and the other livestock enterprises were the same regardless of the particular objective function being maximized.

Enterprise Budgets

The prices received and paid by farmers used in developing the following crop and livestock budgets are shown in Tables 5 and 6. These prices repre-

TABLE 5 - PRICE ASSUMPTIONS USED IN ESTIMATING REVENUES AND EXPENSES FOR CROP AND LIVESTOCK ACTIVITIES DURING 1970-1975: INPUT PRICES (DOLLARS)

Activity	Unit	Price	Activity	Unit	Price
Seed:			Fuel and Oil:		
Corn	Bushel	10.10	Gasoline	Gallon	0.21
Milo	Pound	0.12	Oil	Gallon	0.82
Wheat	Bushel	3.20			
Fescue	Pound	0.20	Custom Rates:		
Oats	Bushel	1.25	Harvest Grains		
Barley	Bushel	1.25	Corn	Acre[a]	5.00
Alfalfa	Pound	0.65	Milo	Acre[a]	5.00
Red Clover	Pound	0.30	Wheat	Acre	5.00
Sudan	Pound	0.12	Oats	Acre	5.00
			Barley	Acre	5.00
Fertilizer:					
Anhydrous Ammonia			Harvest Roughages		
(82%)	Cwt.	6.10	Corn Silage	Acre	10.00
Ammonium Nitrate			Milo Silage	Acre	10.00
(33%)	Cwt.	3.80	Hays	Bale	0.30
6-24-24	Cwt.	3.65	Cleaning	Pound	0.01
15-15-15	Cwt.	3.55	Drying	Bushel	0.08
Lime	Ton	6.50			
Labor:					
General Farm Work	Year	3,600.00			
Hired Seasonal Labor	Hour	1.35			

[a]Plus $0.05 per bushel.

TABLE 6 - PRICE ASSUMPTIONS USED IN ESTIMATING REVENUES AND EXPENSES FOR CROP AND LIVESTOCK ACTIVITIES DURING 1970-1975: PRODUCT PRICES (DOLLARS)[a]

Activity	Unit	Price
Crops		
Corn (Raised)	Bushel	$ 1.10
Corn Purchased	Bushel	1.17
Corn Silage	Ton	8.00
Wheat	Bushel	1.75
Wheat Straw	Bale	0.24
Barley	Bushel	0.85
Barley Straw	Bale	0.24
Milo	Bushel	1.00
Milo Silage	Ton	7.00
Oats	Bushel	0.70
Oat Hay	Ton	16.50
Oat Straw	Bale	0.24
Red Clover Hay	Ton	20.00
Red Clover Seed	Pound	0.30
Alfalfa Hay	Ton	24.00
Sudan Grass	Ton-Hay equiv.	11.00
Legume Hay	Ton	20.00
Legume Grass	Ton-Hay equiv.	11.00
Rotation Pasture	Ton-Hay equiv.	11.00
Livestock		
Milk	Cwt.	$ 4.50
Calves (1 week old)	Head	30.00
Cull Cows (Dairy)	Cwt.	13.50
Cull Cows (Beef)	Cwt.	15.00
Stocker Calf	Cwt.	24.50
Feeder Pigs	Head	15.00
Slaughter Hogs	Cwt.	16.00
Cull Sows	Cwt.	13.00

[a]Farm Price.

sent levels assumed to be representative of future economic developments and were taken from several sources. The primary source was the *Missouri Farm Planning Guide* which provided much of the input-output data used in the various budgets.[4] In the case of milk, dairy husbandry personnel estimated the price that would be necessary for dairy farmers to remain competitive during the 1970-1975 period. For the items not covered in the Planning Guide, prices were set based on information provided by local sources in Franklin County. Cropping practices and livestock production practices utilized technology levels

[4]University of Missouri, *Farm Business Planning Guide* (University of Missouri, Agricultural Experiment Station, Research Bulletin 6500, October, 1965).

stated previously. On the basis of the input prices, product prices, and technology levels, crop and livestock budgets were developed for the particular area in question.

Crops. Cropping activities were permitted that represent reasonable alternatives for the farmers in Franklin County. Labor requirements as well as estimated costs and returns were developed for corn grain or silage, milo grain or silage, barley, oats, wheat, oat hay, red clover hay, alfalfa hay, legume grass hay, and various pasture crops required by different types of livestock enterprises. Crop rotations were developed that satisfied the maximum cropping intensities of the various land types in Areas 1 and 2.

The allowable crops and rotations for each area are given in Table 7. The costs and returns, labor coefficients, and method of calculating the coefficients for the rotations are given in the Appendix.

Livestock. Livestock enterprises in this study include feeder pig, market hog, beef, and dairy production. The coefficients developed are for an economic unit of the particular activity. The coefficients for the swine enterprises and the beef enterprises came primarily from the *Farm Planning Manual.*[5] The budgets developed for the dairy enterprises were based on information presented in the *Missouri Farm Planning Guide.* The livestock enterprises included are those that could utilize the production of the modal land resources in the area.

The feeder pig production system consists of a sow producing two litters per year with eight pigs per litter. Pigs farrowed in March are sold in May and those farrowed in September are sold in November. The market hog production system is similar to the feeder pig operation with 220 hogs being sold in September and February. The beef enterprise is a cow and calf production system with the calves sold as 450 pound feeders.

Two dairy systems are included, one with pasturing and one without pasture. The pasture enterprise assumes grazing for a six month period. Production per cow is assumed as 12,000 pounds (4% basis) annually. A 25 percent culling rate and raising of replacements are assumed. The dry-lot system assumes a yield of 13,500 pounds of milk (4% basis)annually because of better balanced and more uniform rations plus lower maintenance requirements. Replacements are raised and pasturing rather than dry-lot feeding is assumed for the young stock.

Coefficients in costs and returns for the various livestock enterprises are given in the Appendix.

RESULTS OF COMPUTATIONS

Programs were run that allowed maximization of three profit functions using two land areas, three levels of labor, two pasturing practices, and two herd size restrictions. The objective functions allowed the program to maximize re-

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[5]Estel H. Hudson and Robert M. Ray, *Farm Planning Manual: A Guide for Increasing Income* (University of Tennessee, Agricultural Extension Service, E. C. 622, June, 1966), pp. 45-46.

TABLE 7 - ROTATIONS SATISFYING MAXIMUM LAND USE INTENSITIES FOR SOILS OF AREAS 1 AND 2

		Area 1			Area 2	
Rotation[a]	Rotation In Years	Permissable on Nonterraced Upland Cropland	Permissable on Terraced Upland Cropland	Permissable on Bottomland	Permissable on Upland Cropland	Permissable on Bottomland
Continuous Corn	b			yes		yes
Continuous Corn Silage	b			yes		yes
Continuous Milo	b			yes		yes
Continuous Milo Silage	b			yes		yes
Continuous Alfalfa	b			yes		yes
Continuous Red Clover Hay and Seed	b			yes		yes
Continuous Legume Hay	b			yes		yes
Continuous Permanent Pasture	b			yes		yes
C-O-Rc-Rc	4	yes	yes	yes		yes
C-Cs-W-Rc	4		yes	yes		yes
C-O-A-A-A-A	6	yes	yes	yes	yes	yes
C-B-Rc-Rc	4	yes	yes	yes		yes
C-O-LgH-LgH	4	yes	yes	yes		yes
C-O-Rp-Rp	4	yes	yes	yes		yes
S-W-Rc	3	yes	yes	yes	yes	yes
S-W-Rc-Rc	4	yes	yes	yes	yes	yes
Cs-Cs-W-Rc	4		yes	yes		yes
C-Cs-O-Rc	4		yes	yes		yes
C-W-A-A-A-A	6	yes	yes	yes	yes	yes
C-W-Rp-Rp-Rp	5	yes	yes	yes		
C-W-Rp-Rp-Rp-Rp	6	yes	yes	yes	yes	yes

TABLE 7 - (Continued)

Rotation[a]	Rotation In Years	Area 1: Permissable on Nonterraced Upland Cropland	Area 1: Permissable on Terraced Upland Cropland	Area 1: Permissable on Bottomland	Area 2: Permissable on Upland Cropland	Area 2: Permissable on Bottomland
S-O-Rc	3	yes	yes	yes	yes	yes
S-O-Rc-Rc	4	yes	yes	yes	yes	yes
C-S-W-Rc	4	yes	yes	yes		yes
C-M-A-A-A-A	6	yes	yes	yes	yes	yes
C-M-Rp-Rp	4	yes	yes	yes		yes
Cs-B(s)-W-Rc	4	yes	yes	yes		yes
Cs-B(s)-W-Rp-Rp	5	yes	yes	yes		yes
C-Ms-W-Rc	4		yes	yes		yes
Cs-Ms-W-Rc	4		yes	yes		yes
C-Ms-O-Rc	4		yes	yes		yes
C-Oh-Rc-Rc	4	yes	yes	yes		yes
C-Oh-A-A-A-A	6	yes	yes	yes	yes	yes
C-Oh-Rp-Rp	4	yes	yes	yes		yes
C-Cs-W-Rc(s)	4	yes	yes	yes		yes

[a]Symbols used in defining the rotations represent the crops used in the rotation:

C = Corn		A = Alfalfa Hay	
Cs = Corn Silage		Rc = Red Clover Hay	
M = Milo		Rp = Rotation Pasture	
Ms = Milo Silage		Oh = Oat Hay	
B = Barley		LgH = Legume Hay	
O = Oats		S = Sudan Grass	
W = Wheat			

[b]Length of rotation is unspecified.

turns when (1) pasture feeding was the only permissible pasturing practice, (2) dry-lot feeding was the only permissible pasturing practice, and (3) the program was allowed to consider both practices simultaneously. The third alternative was run first and since only dry-lot feeding entered the solutions it was not necessary to run the dry-lot only solution. Solutions with only pasture feeding allowed were obtained to determine the magnitude of the advantage of dry-lot feeding.

The inclusion of dairying enterprises presents a difficulty that resulted in an additional number of solutions being run; the returns to dairying were regarded as fixed with respect to size of operation, *i.e.,* the profits per cow were constant regardless of the number utilized in the solution while the amount of labor required per cow was assumed to be less as cattle numbers surpassed 59 head. With this formulation the program would select the dairy activity with the lowest labor requirements, assuming of course, that dairying was feasible in the optimal solution. Because of this, programs were run that allowed only one labor resource situation for dairying to be present during a solution. After all of the solutions were obtained using this labor requirement, the programs were recomputed using the second labor requirement and the two sets of solutions were compared to determine which would be more realistic.

Optimal Solutions with Dry-Lot Feeding

Table 8 indicates the programmed optimal resource combinations for Area I with both forage alternatives permitted, three labor constraint systems, and dairy enterprises with the labor requirements for the 0 to 59 herd size. The solution for the low labor level indicates that the optimum farm size is 235.2 acres compared to 397.2 acres and 562.2 acres for the medium and high labor levels. In all cases, the solution indicated purchase of land that contained upland cropland in unterraced form.

Feeder pig production appeared in the solution for the two higher labor levels while dairying appeared in all of the solutions. The solutions had dairy herd sizes of 30, 56, and 81 head as labor inputs were increased and all were with the dry-lot feeding system. Total production was 4,118 cwt. of milk for the low labor level, while the production levels increased to 7,620 and 10,977 cwt. for the medium and high labor levels. As the labor constraints increased, the gross income to fixed factors increased approximately $12,000 as each additional man was included, beginning at $14,183.60 and increasing to $38,397.20 for the highest labor level. The capital investment required increased by approximately $30,000 per man as the labor supplies rose.

Table 9 represents the programmed optimal resource combinations for Area 1 with dairy labor requirements per head based on a herd size of 60 or more cows. The optimal size of farm for the low labor level totaled 247.7 acres with upland cropland in unterraced form. The optimal acreage was 419.7 acres for the medium labor system and 594.6 for the high labor system. Again, the so-

TABLE 8 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 1 AT SPECIFIED LABOR LEVELS WITH DRY LOT FEEDING AND HIGH DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	235.2	397.2	562.2
Upland Cropland --				
Unterraced	Acres	119.8	202.5	286.5
Bottomland	Acres	27.9	47.0	66.6
Woods and Wastes	Acres	58.1	98.0	138.8
Permanent Pasture Land	Acres	29.4	49.7	70.2
Crop Enterprises Included				
3 Permanent Pasture	Acres	8.0	36.1	43.0
1 C-S-W-Rc	Acres	119.8	188.5	224.0
3 C-S-W-Rc	Acres	19.9		
3 Corn	Acres		9.2	15.5
3 Milo Silage	Acres		1.7	8.1
1 C-M-Rp-Rp	Acres		14.0	62.5
Corn Purchase	Bushels	94.6	1,000.0	1,000.0
Livestock Enterprises Included				
Feeder Pigs	Sows		12.1	22.4
Dairy Cattle - Dry Lot	Head	30.5	56.4	81.4[a]
Total Livestock Production				
Feeder Pigs	Head		169.7	313.6
Milk Produced	Cwt.	4,118.4	7,620.1	10,997.1
Hired Labor				
June	Hours	118.7	200.0	200.0
August	Hours	11.2	5.6	
Capital Required	Dollars	34,231.8	65,336.0	95,297.3
Gross Income to Fixed Factors	Dollars	14,183.6	26,786.4	38,397.2
Unused Resources				
Pasture Grown	Ton Hay-Equiv.		15.9	80.8
Hay Grown	Ton Hay-Equiv.	21.2		
Woods and Wastes	Acres	58.1	98.0	138.8
Permanent Pasture Land	Acres	29.4	49.7	70.3

[a]This value exceeds the herd size that requires the L_1 labor requirements per cow; results reflect the optimal number of dairy cattle under these particular assumptions.

TABLE 9 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 1 AT SPECIFIED LABOR LEVELS WITH DRY LOT FEEDING AND LOW DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	247.7	419.7	594.6
Upland Cropland -- Unterraced	Acres	126.3	212.9	303.0
Bottomland	Acres	29.3	49.7	70.4
Woods and Wastes	Acres	61.1	103.6	146.8
Permanent Pasture Land	Acres	31.0	52.5	74.4
Crop Enterprises Included				
3 Permanent Pasture	Acres	13.7	36.2	43.0
1 C-S-W-Rc	Acres	126.3	186.5	220.9
3 C-S-W-Rc	Acres	15.6		
1 C-M-Rp-Rp	Acres		27.4	82.0
3 Corn	Acres		9.9	16.5
3 Milo Silage	Acres		3.6	10.8
Corn Purchase	Bushels	341.3	1,000.0	1,000.0
Livestock Enterprises Included				
Feeder Pigs	Sows		14.3	25.6
Dairy Cattle - Dry Lot	Head	33.4[a]	60.3	87.0
Total Livestock Production				
Feeder Pigs	Head		200.9	358.6
Milk Produced	Cwt.	4,517.5	8,141.2	11,749.1
Hired Labor				
June	Hours	191.6	200.0	200.0
August	Hours	15.4	9.7	
Capital Required	Dollars	37,334.0	70,060.7	102,115.8
Gross Income to Fixed Factors	Dollars	15,302.5	28,467.8	40,831.6
Unused Resources				
Pasture Grown	Ton Hay-Equiv.		34.1	107.1
Hay Grown	Ton Hay-Equiv.	15.3		
Woods and Wastes	Acres	61.1	103.6	146.8
Permanent Pasture Land	Acres	40.0	52.5	74.4

lutions indicated that the land purchased would be the land mix that contained upland cropland in unterraced form.

Feeder pigs entered the solutions for the two larger labor levels and dairying with dry-lot pasturing entered all the solutions. Herd sizes as labor inputs increased were 33, 60, and 87 head. Since 60 head are required for the solution to be valid the one man operation can be considered feasible with these labor requirements. This latter solution, however, is preferable for the two-man and three-man operations.

The capital investment varied from $37,334 for the one-man operation to $102,116 for the high labor level; the differential between labor levels was approximately $32,000 per man. The gross income to fixed factors was $15,302.5 for the lowest labor level and increased to $40,832 for the highest level at increments approximately equal to $12,500.

The programmed optimal resource solutions for Area 2 corresponding to those for Area 1 are presented in Tables 10 and 11.

For Area 2, the only livestock enterprise that entered the optimal solutions for the low, medium, and high labor constraints was dairying. The objective function allowed simultaneous consideration of pasture and dry-lot feeding of dairy cattle. Under this system, the optimal solutions for the three labor levels indicated that dairy cattle should be dry-lot fed. With the labor coefficients for herd sizes of less than 60 head, the medium and high labor constraint systems had herd sizes of 65 and 97 head while the herd size for the one man firm would

TABLE 10 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 2 AT SPECIFIED LABOR LEVELS WITH DRY-LOT FEEDING AND THE HIGH DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	153.7	390.1	634.6
Upland Cropland	Acres	62.2	157.8	256.3
Bottomland	Acres	18.3	46.4	75.5
Woods and Wastes	Acres	48.9	124.3	202.2
Permanent Pasture Land	Acres	24.3	61.6	100.2
Crop Enterprises Included				
1 S-W-Rc	Acres	33.6	46.8	73.8
1 C-M-A-A-A-A	Acres	20.6	47.6	69.9
2 Corn	Acres	18.3	46.4	75.5
Corn Purchase	Bushels	1,000.0	1,000.0	1,000.0
Livestock Enterprises Included				
Dairy Cattle - Dry-lot	Head	32.8	65.2[a]	97.5[a]
Total Livestock Production				
Milk Produced	Cwt.	4,421.7	8,805.5	13,160.2
Hired Labor				
May	Hours	5.8	46.3	74.2
June	Hours	63.6	106.1	169.1
Capital Required	Dollars	35,232.0	70,246.3	105,204.4
Gross Income to Fixed Factors	Dollars	13,306.0	25,995.0	38,649.1
Unused Resources				
Upland Cropland	Acres	8.0	63.4	113.1
Woods and Wastes	Acres	48.9	124.3	202.2
Permanent Pasture Land	Acres	24.3	66.6	100.2

[a]This value exceeds the herd size that requires the L_1 labor requirements per cow; results reflect the optimal number of dairy cattle under these particular assumptions.

TABLE 11 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 2 AT SPECIFIED LABOR LEVELS WITH DRY-LOT FEEDING AND THE LOW DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	175.6	439.2	718.1
Upland Cropland	Acres	71.1	177.7	290.5
Bottomland	Acres	20.9	52.3	85.5
Woods and Wastes	Acres	55.9	139.9	228.9
Permanent Pasture Land	Acres	27.7	69.3	113.4
Crop Enterprises Included				
1 S-W-Rc	Acres	31.5	52.2	71.7
1 C-M-A-A-A-A	Acres	24.5	52.1	17.4
2 Corn	Acres	20.9	52.3	85.5
Corn Purchase	Bushels	1,000.0	1,000.0	1,000.0
Livestock Enterprises Included				
Dairy Cattle - Dry-lot	Head	36.1[a]	71.7	107.2
Total Livestock Production				
Milk Produced	Cwt.	4,872.0	9,679.8	14,475.4
Hired Labor				
May	Hours	21.7	69.0	115.9
June	Hours	71.3	135.8	200.0
July	Hours		0.6	6.2
Capital Required	Dollars	38,784.3	77,264.7	115,697.2
Gross Income to Fixed Factors	Dollars	14,584.6	28,510.2	42,382.6
Unused Resources				
Upland Cropland	Acres	15.1	73.4	138.9
Woods and Wastes	Acres	55.9	139.9	228.9
Permanent Pasture Land	Acres	27.7	69.3	113.4

[a]A herd size of 36.1 head is not a feasible solution as the L_2 labor coefficients are applicable only when the herd size is 60 or more head.

be 32 head. With the more efficient labor coefficients (60+ head), the herd sizes would be 36, 71, 107.

Cropping enterprises in Area 1 are more varied than those in Area 2 but both areas utilize upland cropland in non-terraced form. Feeder pigs enter the optimal solutions for Area 1 farmers but Area 2 farmers would specialize in dairying and have optimal herd sizes that are somewhat larger than the programmed herd sizes for Area 1. Total capital investment levels are quite similar even though total acreages are different. The gross income levels for the two systems also are similar.

Optimal Solutions with Pasturing

To compare forage systems, solutions were obtained where the objective function being maximized allowed only pasture feeding for six months. Analysis of these solutions indicated that the optimal herd sizes with dairy labor constraints at the less efficient levels were less than 60 head. The programmed solutions for Area 1 with the higher dairy labor requirements are presented in Table 12. The programmed optimal acreages were 228.7 acres for the low labor system, 260.4 acres for the medium labor level, and 497 acres for the high labor system. The included crop rotations were generally the same.

Dairying was the the dominating livestock enterprise in the programmed solutions with feeder pig and market hog enterprises supplementing this activity. Dairy herd sizes were 25, 42, and 55 head. The swine operations were at low

TABLE 12 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 1 AT SPECIFIED LABOR LEVELS WITH PASTURING AND WITH HIGH DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	228.7	360.4	497.0
Upland Cropland --				
Nonterraced	Acres	116.6	183.7	253.3
Bottomland	Acres	27.1	42.7	58.8
Woods and Wastes	Acres	56.4	88.9	122.7
Permanent Pasture Land	Acres	28.6	45.1	62.2
Crop Enterprises Included				
3 Milo Silage	Acres	5.9	14.0	19.9
1 C-S-W-Rc	Acres	116.6	183.7	253.3
3 C-S-W-Rc	Acres	20.0	12.3	
3 C-Oh-Rp-Rp	Acres	1.2	4.8	
3 C-M-Rp-Rp	Acres		0.2	10.5
3 Corn	Acres		11.4	28.4
Livestock Enterprises Included				
Dairy Cattle - Pasture Fed	Head	25.3	42.7	55.6
Market Hogs	Sows	2.1		2.3
Feeder Pigs	Sows	4.0	25.1	50.4
Total Livestock Production				
Milk Produced	Cwt.	3,039.0	5,119.2	6,683.3
Market Hogs Sold	Cwt.	63.2		70.6
Feeder Pigs Sold	Head	56.2	351.5	705.3
Hired Labor				
June	Hours	186.9	200.0	200.0
August	Hours	25.5	21.0	22.0
September	Hours	12.8		
Capital Required	Dollars	28,048.3	50,281.3	70,841.2
Gross Income to Fixed Factors	Dollars	11,341.6	21,300.2	30,903.7
Unused Resources				
Woods and Wastes	Acres	56.4	88.9	122.7
Permanent Pasture Land	Acres	28.6	45.1	62.2
Cattle Pasture	Ton-Hay Equiv.	18.9		

levels for all labor systems except the high labor system where 50 sows producing feeder pigs were included in the solution.

The program solutions for Area 2, with the same objective function, constraint systems, and the more efficient labor coefficients are presented in Table 13. Program results indicated that the optimum size of farm was just above 150

TABLE 13 - PROGRAMMED OPTIMAL SOLUTIONS FOR AREA 2 AT SPECIFIED LABOR LEVELS WITH PASTURING AND THE HIGH DAIRY LABOR COEFFICIENTS

Item	Unit	Low Labor	Medium Labor	High Labor
Land Purchased	Acres	152.2	300.8	415.7
Upland Cropland	Acres	18.2	121.6	168.2
Bottomland	Acres	61.5	35.8	49.5
Woods and Wastes	Acres	48.5	95.9	65.6
Permanent Pasture Land	Acres	24.0	47.5	65.6
Crop Enterprises Included				
1 S-W-Rc-Rc	Acres	3.4	12.9	35.2
1 C-W-A-A-A-A	Acres	58.1	108.8	127.8
2 Milo Silage	Acres			12.5
2 Corn	Acres	18.1	31.6	37.0
2 Clover	Acres		4.2	
Corn Purchase	Bushels	179.8	864.0	1,000.0
Livestock Enterprises Included				
Dairy Cattle - Pasture Fed	Head	29.4	59.0	84.3[a]
Total Livestock Production				
Milk Produced	Cwt.	3,525.6	7,083.8	10,119.7
Hired Labor				
May	Hours	104.0	180.0	180.0
June	Hours	93.6	199.6	200.0
July	Hours	77.5	134.8	83.2
August	Hours	0.1	9.3	
September	Hours	50.7	88.7	121.0
Capital Required	Dollars	29,277.0	58,660.0	83,342.8
Gross Income to Fixed Factors	Dollars	9,796.8	19,579.0	27,459.6
Unused Resources				
Upland Cropland	Acres			5.1
Woods and Wastes	Acres	48.5	95.9	132.4
Permanent Pasture Land	Acres	24.0	47.5	65.6

[a]This value exceeds the herd size that requires the L_1 labor requirements per cow; results reflect the optimal number of dairy cattle under these particular assumptions.

acres for the one-man operation, 300.8 acres for the medium and 415.7 acres for the high labor system. Again, the only livestock enterprise included in the programmed optimal solutions for Area 2 was dairying. The herd size increased as the labor scale increased with the sizes being 29, 59, and 84. Thus the less efficient labor coefficients should be used for the one-man operation which lacks sufficient labor to reach the size necessary to take advantage of most of the size efficiencies.

Comparison of optimal solutions for Area 1 and 2 with pasture feeding showed optimal farm sizes and incomes to be lower in Area 2 than in Area 1. Cropping rotations included were of different crops and lengths with more hay growing activities in the solutions for Area 2 than Area 1; rotations with rotation pasture included therein were found in the solutions for Area 1 but not in the solutions for Area 2. This is primarily due to the inclusion of supplementary swine enterprises in the solutions for Area 1 while Area 2 solutions indicated specialization in dairying. The swine enterprises demand roughages primarily supplied by rotations including rotation pastures

Dry-Lot Feeding Versus Pasture Feeding

As was mentioned previously, the primary objective of this study was to investigate the relative profitability of two different cattle foraging techniques: dry-lot feeding versus pasturing of dairy cattle. Consideration of the capital investment and gross income levels for the optimal solutions under the two systems can be used to compare the relative profitability of the individual foraging systems. Any particular capital investment would be undertaken only if the expected future returns were greater than the cash outlay or outlays. In this analysis, the additional capital investment was assumed to be undertaken at one point in time, while the resulting output was spread over the time period of interest. With a continuous output over the time period, the value of the output in future years was not comparable to income in other years due to the fact that the output was technically a different product in the different years. To obtain comparable income returns for the output over the time period, present value coefficients were used to discount the value of returns received in the future to their value at the present time. This permits the farmer to consider that future income may never materialize, the opportunity cost of capital, and the subjective time preference of people for money. To determine the profitability of dry-lot versus pasture feeding of dairy cattle, a form of capital budgeting was applied to the programmed solutions.[6]

For Area 1, the programmed optimal capital investment levels for the dry-lot forage system were much greater than the investment levels for the pasture-

[6]Capital budgeting stresses the relevancy of the sum of discounted flows of income after taxes for farm investment decision making. The annual cash flows are a major determinant of the investments that the farmer may undertake successfully.

fed solutions. These investment differentials were probably the result of the increased capital requirements, per cow, of the dry-lot systems. For the one-man operation or low labor supply, the capital investment in the dry-lot system was $35,231.80 or $6,186.50 more than the programmed capital investment required in the pasture-fed forage system. For the medium labor supply, the capital investment for the dry-lot forage system was $65,336.00 while the pasture-fed system indicated a capital investment of $50,281.30 or $15,054.70 less than the dry-lot requirement. For the three-man operation or high labor supply, the capital investment for the dry-lot operation was $95,297.30 and exceeded the capital investment for the pasture-fed operation by $24,456.10. Profit levels for the optimal solutions of the dry-lot and pasture-feeding forage systems indicated that the dry-lot pasturing practice had greater programmed income resulting from the optimal mixes than did the pasture-fed system. For the one-man operation, the programmed solution for the dry-lot dairy system indicated that an income of $14,183.60 would be forthcoming compared to $11,341.60 for the pasture-fed system with the same labor supply. The medium labor supply or two-man operation indicated that the dry-lot forage system had a programmed income level of $26,786.40 while the pasture-fed operation had an income of $21,300.20. The high labor system reflected the fact that $38,397 would be forthcoming from the optimal solution for the dry-lot system whereas $30,908 would be resulting from the pasture-fed forage system.

To investigate the profitability of switching from the pasture-fed forage system to the dry-lot forage system, the stream of discounted incomes or returns resulting from adoption of the dry-lot system must be compared to the differential in capital investment between the two forage systems. For any labor supply situation, confinement feeding would be adopted only when the sum of the discounted returns from this forage system surpassed the additional capital investment required. In other words, the discounted marginal revenue from adoption of the dry-lot system has to be greater than the additional capital investment. A procedure was developed that yielded the values of interest.[7]

For Area 1, with the low labor supply in effect, the differential in capital requirements between the two forage systems is $6,186.50; the sum of discounted returns exceeded this amount for interest rates between 4.0 and 8.0 percent; the sum of the discounted returns from adopting dry-lot feeding of dairy cattle totaled $15,255.86 at an interest rate of 8.0 percent and totaled $18,440.94 at an interest

[7]The procedure was as follows: (1) the capital investment requirement for the pasture-fed system was subtracted from the capital investment requirements of the dry-lot forage system for a particular labor supply, (2) the programmed income level of the pasture-fed system was subtracted from the corresponding income level for the dry-lot system, (3) the value of (2) was multiplied by 80.00 per cent and represents the added income, after taxes, that would be forthcoming from adoption of the dry-lot feeding system, (4) the value of (3) was discounted over a 10-year period, according to various interest levels, and was then summed and represents the sum of the discounted flow of returns that would result from the dry-lot system, and (5) the value computed in (4) was compared to the value computed in (1). If (4) - (1) was a positive figure at the interest rate considered, it was economically feasible to adopt the dry-lot system of dairy cattle feeding.

rate of 4.0 percent. This meant that the farm manager would be able to profitably adopt the dry-lot system of dairy cattle feeding when the opportunity cost of capital is between 4.0 and 8.0 percent. For the medium labor supply, the differential in capital investment between the two forage systems was $15,054.70 and the discounted returns forthcoming from adoption of the dry-lot system totaled $35,598.42 at the 4.0 percent interest rate and $29,449.95 at the 8.0 percent interest rate; for opportunity costs ranging from 4.0 to 8.0 percent, it was economical for the enterpreneur to adopt confinement feeding of dairy cattle.

For the high labor supply situation for Area 1 solutions, the differential in capital investment requirements was $24,456.10. The rational farm manager would adopt the dry-lot forage system if his opportunity cost of capital was between 4.0 and 8.0 percent; the sum of discounted returns resulting from the adoption of the dry-lot system totaled $48,590.78 for an opportunity cost of 4.0 percent and totaled $40,198.27 for an opportunity cost of 8.0 percent. Although the differences in incomes between the two pasturing systems were small in any one year ($2,273.60 for the low labor system, $4,388.97 for the medium labor system, and $5,990.80 for the high labor system), consideration of the sums of discounted net returns indicated that, when compared to investment costs, the dry-lot forage system could profitably be adopted.

A similar comparison of the programmed results with the two systems was made for Area 2. The farm sizes for the optimal solutions with the dry-lot forage system as the valid practice were larger than the corresponding farm sizes for the pasture-fed systems in Area 2, just as was indicated in the optimal solutions for Area 1. The solutions for both forage systems indicated that the only permissable livestock enterprise found in the programmed optimal solutions was dairying, with larger herd sizes being found in the solutions for the dry-lot systems. For the one-man operation or low labor supply, the programmed capital investment totaled $35,232.00 for the dry-lot system and was $5,955.00 more than the required capital investment in the pasture-fed system. A capital investment of $70,246.30 was indicated for the dry-lot pasture system under the medium labor supply while the programmed capital investment for the pasture-fed forage system totaled $58,660.00 or $11,586.30 less. For the high labor supply, the programmed capital investment in the dry-lot forage system was $105,204.00, which was $21,861.60 more than the corresponding investment in the alternative pasturing system.

The gross income resulting from the dry-lot system for the low labor supply was found to be $13,306.00 while the gross income to the pasture-fed system was $3,509.20 less at $9,796.80; for the medium labor supply, gross income for the dry-lot system totaled $25,995.00 while the income with the pasture system was $19,579.90 or $6,415.10 less. For the high labor supply, the gross income with the dry-lot system was $38,649.10, surpassing the income to the pasture system by $11,189.50.

In these terms, it would be feasible to adopt dry-lot feeding of dairy cattle. However, as was the case when considering the feasibility of adopting the dry-lot forage system in the Area 1 solutions, the sum of the discounted returns resulting from adoption of the confinement system must be compared to the additional capital investment required. The criteria for adoption of the dry-lot forage system are the same as before.

For the low labor supply, the capital investment differential between the two forage systems totaled $5,955.00 with the sum of the discounted returns totaling $22,770.24 at an opportunity cost of 4.0 percent and $18,837.38 at an opportunity cost of 8.0 percent. For the medium labor supply, the capital investment differential totaled $11,586.30 and the sum of the discounted returns totaled $41,625.78 at an opportunity cost of 4.0 percent and declined to $34,436.26 at an opportunity cost of 8.0 percent. For the high labor supply, the capital investment differential between the two forage systems totaled $21,861.60 with the sum of the discounted returns at an interest rate of 4.0 percent, totaling $72,695.52, and totaling $60,065.25 at an opportunity cost or interest rate of 8.0 percent. In all three labor supply situations, the manager can profitably adopt dry-lot feeding of dairy cattle, at least for opportunity costs between 4.0 and 8.0 percent.

Dual Solutions and Shadow Prices

The objective function of the primal solutions was maximization of profit; the dual solutions therefore had the objective of minimizing cost. The values in the table reflect the marginal value (shadow price) of each constraint. These shadow prices indicate how the profit function would be reduced or altered if the activity in question were varied at the margin, *i.e.,* the change in the value of the objective function that would result from a unit change in the amount of the constraint. For nonbasis activities, the shadow prices represents the opportunity cost of introducing this activity into the basis.

Area One Solutions

The dual solutions corresponding to the previously analyzed primal solutions for Area 1 are presented in Table 14. The solutions for Area 1 exhibited certain trends. As the labor supply increased, the optimal farm size, the capital investment levels, and the resulting gross incomes to fixed factors increased. The marginal value of an additional hour of labor supply for a respective month generally decreased as the total labor supply increased. The supply of labor in June was a constraint for all solutions, reflecting the fact that adequate supplies of labor for harvesting greatly aid profit levels; the larger the total postulated labor supply, the higher the shadow prices of June labor and hired seasonal labor in June. As the total labor supplies increased, the marginal value of upland cropland decreased but the shadow price of bottomland increased, indicating that bottomland was being farmed more intensively and would affect profit levels in a resulting manner. For Area 1, the one-man operation had few cropping activi-

TABLE 14 - PROGRAMMED DUAL SOLUTIONS FOR AREA 1 WITH THREE LABOR LEVELS, AND BOTH LOW AND HIGH DAIRY LABOR COEFFICIENTS (DOLLARS)

		High Dairy Labor Coefficients						Low Dairy Labor Coefficients		
		DRYLOT			PASTURE			DRYLOT		
Item	Unit	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor
February Labor	Hour		15.13	16.66	15.00	24.03	24.53		11.21	12.73
March Labor	Hour	27.10	10.78	10.01	17.81			32.08	16.89	16.14
June Labor	Hour	1.35	18.53	18.97	1.35	11.36	11.97	1.35	19.29	19.74
August Labor	Hour	1.35	1.35		1.35	1.35	1.35	1.35	1.35	
October Labor	Hour	26.83			8.34			26.32		
Upland Cropland										
Unterraced	Acre	17.88	15.92	15.85	22.36	19.81	19.30	17.71	15.56	15.50
Terraced	Acre	19.41	17.61	17.55	23.68	21.33	20.82	19.25	17.30	17.24
Bottomland	Acre	24.00	31.15	31.76	27.30	26.55	26.33	23.91	31.44	32.05
Cattle Pasture	Ton hay-equiv.	17.83	18.86	18.60		9.26	11.17	18.47	19.82	19.57
Pasture Grown	Ton hay-equiv.	9.81			25.42	9.96	8.05	10.78		
Hog Pasture	Ton hay-equiv.	27.64	18.86	18.60	25.42	19.22	19.22	29.25	19.82	19.57
Hay Grown	Ton hay-equiv.		20.88	20.69	19.05	19.76	17.80		21.52	21.33

TABLE 14 (Continued)

Item	Unit	High Dairy Labor Coefficients						Low Dairy Labor Coefficients		
		DRYLOT			PASTURE			DRYLOT		
		Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor
Pigs Produced	Head	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Hog Produced	Cwt.	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Feeder Calves	Cwt.	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50
Milk Produced	Cwt.	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Livestock Feed	Cwt.	2.09	2.18	2.19	1.54	1.84	1.84	2.08	2.25	2.27
Hired Labor - June	Hour		17.19	17.63		10.01	10.62		17.94	18.39

ties and there was little or no purchase of corn whereas at the higher labor supplies several crop rotations would be utilized and the maximum allowable level of corn would be purchased. The low labor supply resulted in specialization in dairying with fewer crops. The higher labor supply systems allowed diversification of farming practices and therefore profit levels of these farms would probably be less sensitive to adverse weather conditions, price decreases, and other influences. The price of specialization is less flexibility and thus, the risk factor to a specialized farm would be greater than to a more diversified unit.

Area Two Solutions

The programmed dual solutions for Area 2 are presented in Table 15. As was the case for Area 1, the solutions for Area 2 indicated that the optimal farm sizes, capital investment requirements, and gross incomes to fixed factors increased as the total labor supply increased. The dual solutions, with dry-lot feeding and each of the two dairy cattle labor coefficient levels, indicated that the shadow prices of all the labor constraints except March and April labor approached zero, reflecting the fact that except at critical periods labor was not a very restrictive constraint. As labor supplies increased, the marginal value of an additional acre of bottomland increased, indicating that more abundant labor supplies allowed more intensive use of bottomland acreages and therefore caused an increase in the marginal value of such. As the dairy labor requirements changed from the less to the more efficient level, optimal farm sizes, capital investment requirements, and gross income levels to fixed factors increased, The more efficient dairy labor levels freed additional hours previously required for the livestock enterprise. An increase in labor efficiency is technically similar to an increase in labor supply.

The primal solutions with pasturing revealed that the optimal farm sizes, herd sizes, capital investment levels, and gross income levels all increased as the labor supply increased. At the low labor supply situation, March labor constrained the system while May and June labor supplies were constraining factors in the medium and high labor systems. As the total labor supply grew in magnitude, the shadow price of bottomland increased as a result of more intensive land use and therefore the marginal value of this land increased.

Area Comparisons

Comparison of the dual solutions for Area 1 and Area 2 with dry-lot feeding shows that the shadow prices of labor for Area 1 were generally larger than the values for Area 2. Additional acres of upland cropland had positive marginal values in Area 1 but not in Area 2, where some of the purchased upland cropland was not utilized. However, the marginal value of bottomland was higher for Area 2 than for Area 1, reflecting the profitability of an additional acre of bottomland. The farmers of Area 2 should be willing to pay more for bottomland than Area 1 farmers. Upland cropland in Area 1 was more productive than

TABLE 15 - PROGRAMMED DUAL SOLUTIONS FOR AREA 2 WITH THREE LABOR LEVELS, AND BOTH HIGH AND LOW DAIRY LABOR COEFFICIENTS (DOLLARS)

		High Dairy Labor Coefficients						Low Dairy Labor Coefficients		
		DRYLOT			PASTURE			DRYLOT		
Item	Unit	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor
March Labor	Hours	48.30	29.42	29.42	32.17	31.46		53.41	34.44	10.10
April Labor	Hours		18.38	18.38					16.95	38.56
May Labor	Hours	1.35	1.35	1.35	1.35	1.84	13.72	1.35	1.35	1.35
June Labor	Hours	1.35	1.35	1.35	1.35	1.35	12.12	1.35	1.35	3.37
July Labor	Hours				1.35	1.35	1.35		1.35	1.35
August Labor	Hours				1.35	1.35				
September Labor	Hours				1.35	1.35	1.35			
Upland Cropland	Acres				10.11	10.98				
Bottomland	Acres	70.07	81.93	81.93	30.04	29.42	75.51	67.23	81.93	81.93
Cattle Pasture	Ton hay-equiv.	1.57			2.32	2.01		1.94		
Pasture Grown	Ton hay-equiv.	26.91			21.96	21.88			22.16	11.94
Hog Pasture	Ton hay-equiv.							1.94		
Hay Grown	Ton hay-equiv.	8.66	7.51	7.51	19.19	20.12	35.20	9.04	9.06	11.26

TABLE 15 (Continued)

		High Dairy Labor Coefficients						Low Dairy Labor Coefficients		
		DRYLOT			PASTURE			DRYLOT		
Item	Unit	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor	Low Labor	Medium Labor	High Labor
Pigs Produced	Head	22.50	22.23	22.23	18.20	18.13	17.30	23.48	23.25	22.14
Hogs Produced	Cwt.	21.42	21.94	21.94	17.05	17.01	19.96	21.87	22.57	22.23
Feeder Calves	Cwt.	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50
Milk Produced	Cwt.	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Livestock Feed	Cwt.	3.03	3.32	3.32	2.09	2.08	3.53	3.02	3.35	3.43
Hired Labor - May	Hours						12.37			
Hired Labor - June	Hours						10.78			2.02

the upland cropland in Area 2 and therefore could be cropped more intensively and was fully utilized in the solutions.

Comparison of the dual solutions for Area 1 and Area 2 with pasturing disclosed that again the shadow prices of labor for Area 2 were lower than the shadow prices of labor for the Area 1 situations. March labor again was the most constraining month for Area 2 farms with the marginal values declining as the total labor supply increased. With dairy cattle being pasture-fed, the shadow prices of upland cropland were positive for Area 2 under the lower labor supply systems and all labor systems resulted in positive shadow prices for upland cropland in Area 1. The value of bottomland again was much larger for Area 2 than for Area 1

SENSITIVITY ANALYSIS

One of the primary assumptions of linear programming is that the parameters of the constraints as well as activities remain constant. However, in real world situations the parameters may not be constant: the inclusion of an activity in an optimal solution is valid over some range of its price or cost parameters; this means that the price or cost of an activity may vary over some range and will not cause variations in the levels of activities in the final solution. It is therefore of interest to determine these parameter ranges for the basis activities in the optimal solutions because evaluation of the stability of the solutions can then be made.

As the cattle pasturing practice changed from pasture feeding of dairy cattle to confinement feeding, the cost ranges of the crop enterprises included in the optimal solutions were more stable for confinement feeding than for the pasture-feeding systems. In other words, farmers who allow their dairy cattle to graze should be more aware of price or cost fluctuations than farmers who confine their livestock; the farmers with pasture feeding of dairy cattle need to be more aware of these fluctuations in order to maintain income levels comparable to the farmers who confine their dairy cattle. The farms that adopted confinement feeding of dairy cattle were smaller than the farms that did not but the former had higher income levels than those with pasture feeding. The stability of the livestock enterprises was again greater for the farmer who adopted confinement feeding.

Data provided by cost ranging revealed little difference in sensitivity of the programmed basis activities as the labor supplies increased. There was a tendency, however, for the cost ranges of the livestock enterprises to widen. This meant that these levels became more stable in the solution and were less sensitive to price or cost fluctuations.

As the dairy cattle labor requirements decreased or became more efficient, the cost ranges of the basis activities widened. In other words, the programmed optimal levels of the basis activities became more stable and would remain in the solution at that level over a wider cost range. An increase in labor efficiency is equivalent to an increase in total labor supply.

In general, the cost ranges of the basis crop activities for the Area 2 situations were larger than the corresponding ranges in the Area 1 situations. Also, many of the activities for Area 1 were at basis cost levels close to the cost interval limits. The general tendency was for the cropping activities of Area 1 to be more sensitive to cost changes than were the corresponding activities of Area 2. In addition, the livestock enterprises included in the solutions for Area 1 were more sensitive to cost changes than were the basis livestock enterprises of Area 2.

Cropping activities of Area 1 were more sensitive to cost changes than were Area 2 cropping enterprises, which probably resulted from upland cropland of Area 1 being more productive than upland cropland of Area 2. As a result of this differential in land productivity, cropland of Area 1 has many possible alternative crop rotations that may be considered in the optimal solutions; Area 2 has fewer.

CONCLUSIONS AND IMPLICATIONS

The basic purpose of this study is to investigate the benefits arising from dry-lot feeding of dairy cattle relative to present feeding practices; comparisons are made between systems or programs that allow dry-lot feeding or pasture feeding of dairy cattle.

To determine the optimal resource combinations, the crop and livestock enterprises, and the resulting income levels from these enterprises, estimated costs and returns for cropping, and livestock activities have been developed and presented. The costs and returns of the crop enterprises are reasonable approximations of production costs and product prices during 1970 to 1975. Crop rotations for a particular area are those that satisfy the maximum land use intensity level for a land type in the area of interest. The livestock enterprises with corresponding budgets also are representative of those to be found in Franklin County. Linear programming is used in the study to determine the optimal combinations of resources subject to various labor restrictions, land resource mixes, and pasturing practices that would maximize profit.

Given the simultaneous choice of two pasturing techniques, pasture feeding and confinement feeding of cattle, the solutions show that confinement feeding is the most profitable for the resource situations, production coefficients, prices, and costs used. The profit levels resulting from the solutions containing dry-lot feeding are larger than those from the programmed optimal solutions for the pasture-fed forage system. Total capital investment levels are higher for the dry-lot forage system but capital budgeting of the income flows indicated that adoption of the dry-lot forage system was economically feasible and should be accepted if the manager is interested in profit maximization. As expected, herd sizes for the confinement forage system are larger than the programmed herd sizes for the pasture system. The cost ranges for activities in the solution also indicate that the confinement systems are less sensitive to price and cost changes.

The dry-lot forage system can be adopted profitably by farmers in both soil association areas of the study. This forage system requires additional capital investments but farm and herd sizes can be larger with a given labor supply. Total livestock production levels are greater and income levels can be larger for the dry-lot systems.

APPENDIX

COEFFICIENTS, COSTS, AND RETURNS FOR ROTATIONS IN THE PROGRAMMING MODEL

To estimate the input-output coefficients for the crop rotations, a method must be used that provides coefficients that weight the crops according to their frequency in the rotations. The following formula develops the proper crop rotation coefficients:

$$(1)\ C = \frac{\Sigma(X_i \ldots X_n)}{N}$$

where

C = the rotation labor coefficient.
Σ = the sum of X from i to n.
$X_i \ldots X_n$ = the individual crop labor coefficient for the ith through nth crops included in the rotation.
N = the length of the rotation in years.

The labor requirements developed via this formula were incorporated into the matrices used.

It is reasonable to expect different yields for the two areas due to the different productivity levels of soils in them. Estimated yields were based on information provided by the Soil Conservation Service in connection with a framework study of the Missouri River Basin by the Economic Research Service of the United States Department of Agriculture. The Soil Conservation Service predicted yields for the next 50 years according to the following criteria:

(1) Yields have been increasing at an exponential rate for the past 15 years.
(2) Changes in technology as well as increased farmer acceptance of such have played a part in the increase.
(3) No development of irrigation was assumed.
(4) Highest average yields for the past 15 years were used as guidelines although it was recognized that these would be low.
(5) Superior levels of management will be needed during the prediction periods.

The predicting equation for corn grain or silage, milo grain or silage, alfalfa hay, rotation pasture, red clover hay, sudan grass, and legume grass hay is

$$(2)\ Y_{it} = Y_o\,(1 + .04t)$$

where

Y_{it} = Yield of crop i in year t.
Y_o = Normal yield of crop i in 1965.
t = Number of years in the future with t = o in 1965.

Equation (2) allows a 4 percent linear increase in crop yields. This equation is a fair estimator of the exponential functions derived from average yields 1947-

1961 for the respective crops. The exponential equations calculated, on the basis of Crop Reporting Service data, are:

(3) $Y = Y_o \cdot e^{.044t}$ for corn.

(4) $Y = Y_o \cdot e^{.042t}$ for wheat.

(5) $Y = Y_o \cdot e^{.032t}$ for oats.

(6) $Y = Y_o \cdot e^{.023t}$ for all hays.

The predicting equation for wheat, barley, and oats for grain or hay is:

(7) $Y_{it} = Y_o (1 = .02t)$

where the symbols are as defined previously. Again, this equation is a valid estimator of the exponential functions demonstrated by these crops. Woodland pasture and nonimprovable permanent pasture are assumed to have the same general yields in 1970-1975 as they did in 1965. Utilizing the postulated yields and prices, estimated costs and returns for individual crops and rotations were developed.

Basic data and budgets for the individual crops are given in Appendix Tables I through XXI. Rotation coefficients are derived from the data for individual crops by use of equation (2). Livestock data are summarized in Appendix Tables XXIII through XXVI.

APPENDIX TABLE I

ESTIMATED CROP YIELDS FOR AREAS 1 AND 2 DURING 1970-1975 (YIELDS PER ACRE)[a]

		Area 1			Area 2	
Crop	Yield	Unterraced Upland Cropland	Terraced Upland Cropland	Bottomland	Upland Cropland	Bottomland
Corn	Bushel	75.0	80.0	90.0	70.0	85.0
Corn Silage	Ton	14.0	14.5	16.0	13.0	15.0
Wheat	Bushel	40.0	40.0	45.0	37.0	42.0
Milo	Bushel	60.0	62.0	75.0	60.0	75.0
Milo Silage	Ton	14.0	14.0	16.0	13.5	15.0
Oats	Bushel	40.0	40.0	45.0	38.0	40.0
Oat Hay	Ton	3.0	3.0	3.4	2.8	3.4
Barley	Bushel	37.0	37.0	42.0	35.0	40.0
Alfalfa	Ton	3.8	3.8	4.0	3.5	4.0
Red Clover	Ton	2.5	2.5	3.0	2.3	2.8
Legume Grass	Ton	2.8	2.8	3.0	2.5	3.0
Permanent Pasture	Ton-Hay Equiv.	1.8	1.8	2.2	1.6	2.0
Rotation Pasture	Ton-Hay Equiv.	2.8	2.8	3.0	2.5	3.0
Sudan Grass	Ton-Hay Equiv.	3.0	3.0	3.5	3.0	3.5

[a]Yields are based on those presented in the preliminary Missouri Technical Guide for Land Resource Area 115, Soil Conservation Service, June, 1967. Yields adapted from those presented for high level of management, now attainable by the upper 10-15 per cent of the farmers in the area.

APPENDIX TABLE II

ESTIMATED COSTS AND RETURNS PER ACRE FOR SELECTED CROPS ENTERPRISES (AREA 1)

Crop	Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland		
	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns
Corn for Grain	$82.50	$49.02	$33.48	$88.00	$50.23	$37.77	$99.00	$52.04	$46.96
Corn for Silage	112.00	51.99	60.01	116.00	54.90	61.10	128.00	60.89	67.11
Barley	31.45	25.33	17.64	31.45	25.33	17.64	35.70	25.31	22.87
Milo for Grain	60.00	46.95	13.05	62.00	47.48	14.52	75.00	50.51	24.49
Milo for Silage	98.00	45.67	52.33	98.00	47.50	50.50	112.00	53.04	58.96
Wheat	70.00	34.75	47.25	70.00	34.75	47.25	78.75	36.02	54.73
Oats for Grain	35.20	24.58	10.62	35.20	24.58	10.62	39.90	25.72	14.18
Oats for Hay	49.50	24.15	25.35	49.50	24.15	25.35	56.10	25.40	30.70
Alfalfa Hay	91.20	39.40	51.80	91.20	40.18	51.02	96.00	42.07	53.93
Clover Hay and Seed	68.00	35.23	32.77	68.00	35.23	32.77	79.50	36.44	43.06
Legume Grass Hay	50.00	26.64	23.36	50.00	26.64	23.36	60.00	27.75	32.25
Rotation Pasture	30.80	10.73	20.07	30.80	10.73	22.27	33.00	10.73	22.27
Sudan Grass	33.00	19.70	13.30	33.00	19.70	13.30	38.50	20.76	17.74
Permanent Pasture	12.60	6.15	6.45	12.60	6.15	6.45	15.40	6.15	9.25

APPENDIX TABLE III

ESTIMATED COSTS AND RETURNS PER ACRE FOR SELECTED CROP ENTERPRISES (AREA 2)

Crop	Upland Cropland			Bottomland		
	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns
Corn for Grain	$77.00	$50.64	$26.36	$ 93.50	$51.45	$42.05
Corn for Silage	104.00	52.36	51.64	120.00	57.17	62.83
Barley	29.75	25.22	15.33	34.00	25.18	20.82
Milo for Grain	60.00	47.74	12.26	75.00	50.51	24.49
Milo for Silage	94.50	44.05	50.45	105.00	50.65	54.35
Wheat	64.75	34.38	41.89	73.50	35.05	50.45
Oats for Grain	33.80	24.44	9.36	36.40	25.31	11.09
Oats for Hay	46.20	24.03	22.17	56.10	25.40	30.70
Alfalfa Hay	84.00	39.15	44.85	96.00	42.07	53.93
Clover Hay and Seed	63.10	34.98	28.12	75.50	36.30	39.20
Legume Grass Hay	46.00	26.44	19.56	56.00	27.61	28.39
Rotation Pasture	27.50	10.73	16.77	33.00	10.73	22.77
Sudan Grass	33.00	19.70	13.30	38.50	20.76	17.74
Permanent Pasture	11.20	6.15	5.05	14.00	6.15	7.85

APPENDIX TABLE IV

ESTIMATED AVERAGE ANNUAL COSTS AND RETURNS PER ACRE FOR SELECTED CROP ROTATIONS FOR AREA 1, PER ROTATION YEAR: 1970-1975

Rotation[a]	Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland		
	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns
C-O-Rc-Rc	$63.43	$36.02	$27.41	$64.80	$36.32	$28.48	$74.48	$37.66	$36.82
C-Cs-W-Rc	86.13	42.75	43.38	88.50	43.78	44.72	99.31	46.35	52.96
C-O-A-A-A-A	80.42	38.53	41.89	81.33	39.26	42.07	87.15	41.01	46.14
C-B-Rc-Rc	65.37	36.20	29.17	66.74	36.51	30.23	76.55	37.56	38.99
C-O-LgH-LgH	54.43	31.72	22.71	55.80	32.02	23.78	64.73	33.32	31.41
C-O-Rp-Rp	44.83	23.77	21.06	46.20	24.07	22.13	51.23	24.81	26.42
S-W-Rc	61.00	29.89	31.11	61.00	29.89	31.11	69.58	31.07	38.51
S-W-Rc-Rc	62.75	31.23	31.52	62.75	31.23	31.52	72.06	32.42	39.64
Cs-Cs-W-Rc	93.50	44.37	49.13	95.50	45.82	49.68	106.56	49.44	57.12
C-Cs-O-Rc	74.43	40.21	34.22	76.80	41.24	35.56	86.63	43.77	42.86
C-W-A-A-A-A	88.22	40.23	47.99	87.47	40.95	46.52	95.63	42.72	52.91
C-W-Rp-Rp-Rp-Rp	47.95	21.12	26.83	48.87	21.32	27.55	53.63	21.83	31.80
S-O-Rc	45.40	26.50	18.90	45.40	26.50	18.90	52.63	27.64	24.99
S-O-Rc-Rc	51.05	28.69	22.36	51.05	28.69	22.36	59.35	29.84	29.51
C-S-W-Rc	66.38	35.43	30.95	67.75	35.78	31.97	76.94	37.22	39.72
C-M-A-A-A-A	84.55	42.26	42.29	85.80	43.07	42.73	93.00	45.14	47.86

APPENDIX TABLE IV (continued)

Rotation[a]	Unterraced Upland Cropland Gross Income	Unterraced Upland Cropland Specified Expenses	Unterraced Upland Cropland Net Returns	Terraced Upland Cropland Gross Income	Terraced Upland Cropland Specified Expenses	Terraced Upland Cropland Net Returns	Bottomland Gross Income	Bottomland Specified Expenses	Bottomland Net Returns
C-M-Rp-Rp	51.03	29.36	21.67	52.90	29.79	23.11	60.00	31.00	29.00
Cs-B(S)-W-Rc	84.49	42.63	41.86	85.49	43.36	42.13	96.23	45.73	50.50
C-Cs-W-Rc(S)	89.88	48.14	41.74	92.25	49.22	43.03	104.06	52.16	51.90
Cs-B(S)-W-Rp-Rp	66.31	31.35	34.96	67.11	31.93	35.18	74.29	33.59	40.70
C-Ms-W-Rc	82.63	41.17	41.46	84.00	41.93	42.07	95.31	44.39	50.92
Cs-Ms-W-Rc	90.00	42.79	47.21	91.00	43.97	47.03	102.56	47.47	55.09
C-Ms-O-Rc	70.93	39.38	31.55	72.30	40.19	32.11	82.60	42.71	39.89
C-Oh-Rc-Rc	67.00	35.91	31.09	68.38	36.21	32.17	78.53	37.58	40.95
C-Oh-A-A-A-A	82.80	50.73	32.07	83.72	51.65	32.07	89.85	53.91	35.94
C-Oh-Rp-Rp	48.40	23.66	24.74	49.78	23.96	25.82	55.28	24.73	30.55
C-W-Rp-Rp-Rp	51.38	23.19	28.19	52.48	23.43	29.05	57.75	24.05	33.70

[a]Symbols used in defining the rotations represent the crops used in the rotation:

C = Corn	W = Wheat	Rc = Red Clover	( ) = Double Crop
Cs = Corn Silage	B = Barley	Rp = Rotation Pasture	
M = Milo	O = Oats	S = Sudan Grass	
Ms = Milo Silage	Oh = Oat Hay	LgH = Legume Grass Hay	

APPENDIX TABLE V

ESTIMATED AVERAGE ANNUAL COSTS AND RETURNS PER ACRE FOR SELECTED CROP ROTATIONS FOR AREA 2, PER ROTATION YEAR: 1970-1975

	Upland Cropland			Bottomland		
Rotation[a]	Gross Income	Specified Expenses	Net Returns	Gross Income	Specified Expenses	Net Returns
C-O-Rc-Rc	$49.25	$36.26	$22.99	$70.23	$37.34	$32.89
C-Cs-W-Rc	80.09	43.09	37.00	93.63	44.99	48.64
C-O-A-A-A-A	74.47	38.61	35.86	85.65	40.84	44.81
C-B-Rc-Rc	60.94	36.46	24.48	72.63	37.31	35.32
C-O-LgH-LgH	50.70	31.99	18.71	60.48	33.00	27.48
C-O-Rp-Rp	41.45	24.14	17.31	48.98	24.56	24.42
S-W-Rc	57.46	29.69	27.77	63.17	30.70	32.47
S-W-Rc-Rc	58.87	31.01	27.86	68.75	32.10	36.65
Cs-Cs-W-Rc	86.84	44.30	42.54	100.25	48.23	52.02
C-Cs-O-Rc	69.48	40.61	28.87	81.34	42.56	38.79
C-W-A-A-A-A	81.55	40.27	41.28	93.83	42.46	51.37
C-W-Rp-Rp-Rp-Rp	43.88	21.32	22.56	51.83	21.57	30.26
S-O-Rc	43.30	26.37	16.93	50.13	27.46	22.67
S-O-Rc-Rc	48.25	28.53	19.72	56.48	29.67	26.81
C-S-W-Rc	62.34	35.63	26.71	73.25	36.74	36.51
C-M-A-A-A-A	78.83	42.50	36.33	92.08	45.04	47.04
C-M-Rp-Rp	48.00	29.96	18.04	58.63	30.86	27.77

APPENDIX TABLE V (continued)

Rotation[a]	Upland Cropland Gross Income	Upland Cropland Specified Expenses	Upland Cropland Net Returns	Bottomland Gross Income	Bottomland Specified Expenses	Bottomland Net Returns
Cs-B(S)-W-Rc	79.23	42.54	36.69	91.38	44.49	46.89
C-Cs-W-Rc(S)	84.07	48.43	35.64	98.38	50.75	47.63
C-Ms-W-Rc	77.72	41.01	36.71	89.88	43.36	46.52
Cs-B(S)-W-Rp-Rp	61.76	31.32	30.44	71.20	32.62	38.58
Cs-Ms-W-Rc	84.47	42.32	42.15	96.50	45.67	50.83
C-Ms-O-Rc	67.10	39.23	27.87	77.60	41.78	35.82
C-Oh-Rc-Rc	62.35	36.16	26.19	75.15	37.36	37.79
C-Oh-A-A-A-A	76.53	51.06	25.47	88.93	53.65	35.28
C-Oh-Rp-Rp	44.55	24.03	20.52	53.90	24.58	29.32
C-W-Rp-Rp-Rp	47.15	23.44	23.71	55.60	23.74	31.86

[a]Symbols used in defining the rotations represent the crops used in the rotation:

C = Corn	W = Wheat	Rc = Red Clover
Cs = Corn Silage	B = Barley	Rp = Rotation Pasture
M = Milo	O = Oats	S = Sudan Grass
Ms = Milo Silage	Oh = Oat Hay	LgH = Legume Grass Hay
	( ) = Double Crop	

APPENDIX TABLE VI

MONTHLY LABOR REQUIREMENTS FOR CROPS ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND IN TERMS OF HOURS PER ACRE[a]

	Total	Hours											
Crop	Hours	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Corn for Grain													
Upland Non-Terraced	7.80	-	-	0.40	0.50	1.90	1.25	0.58	-	0.38	1.35	1.44	-
Upland Terraced	8.00	-	-	0.41	0.52	1.95	1.28	0.59	-	0.39	1.38	1.48	-
Bottomland	7.60	-	-	0.39	0.48	1.85	1.22	0.57	-	0.37	1.32	1.40	-
Corn Silage													
Upland Non-Terraced	15.00	-	-	0.40	0.50	1.90	1.25	0.58	1.47	9.00	-	-	-
Upland Terraced	15.00	-	-	0.41	0.53	1.96	1.29	0.60	1.52	9.30	-	-	-
Bottomland	14.00	-	-	0.37	0.47	1.74	1.15	0.53	1.36	8.38	-	-	-
Milo - See Corn													
Milo Silage - See Corn Silage													
Oats for Grain													
Same in All Cases	4.00	-	-	1.15	0.85	-	-	2.00	-	-	-	-	-
Oats for Hay													
Same in All Cases	5.85	-	-	1.15	0.85	-	2.75	1.10	-	-	-	-	-
Barley													
Same in All Cases	4.75	-	-	-	-	-	2.00	-	0.95	1.80	-	-	-
Wheat													
Same in All Cases	4.75	-	-	0.40	-	-	1.20	0.70	0.20	0.85	1.40	-	-
Alfalfa Hay													
Same in All Cases	16.00	-	-	-	-	3.68	3.43	3.85	2.29	3.25	-	-	-

APPENDIX TABLE VI (Continued)

Crop	Total Hours	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		Hours											
Rotation Pasture													
Same for All Cases	2.25	-	0.50	0.75	-	-	-	0.75	0.25	-	-	-	-
Legume Grass Hay													
Same in All Cases	10.00	-	0.50	1.25	0.25	-	3.50	3.00	1.50	-	-	-	-
Clover Stubble													
Same in All Cases	6.90	-	0.50	-	-	-	2.00	0.80	3.00	0.60	-	-	-
Clover Hay and Seed[b]													
Same in All Cases	8.00	-	0.50	-	-	-	4.50	-	2.50	0.50	-	-	-
Permanent Pasture													
Same in All Cases	1.20	-	-	0.30	-	-	-	0.20	0.70	-	-	-	-
Sudan for Pasture													
Same in All Cases	3.00	-	-	-	-	0.30	1.50	0.50	0.50	0.20	-	-	-

[a]Labor is based on use of a three-plow tractor and a complement of similar sized field equipment, such as four-row planter, four-row cultivator, two-row harvestor, and 12-foot self-propelled combine.

[b]First cutting for hay, second cutting for seed.

APPENDIX TABLE VII

CORN FOR GRAIN: ESTIMATED COSTS AND RETURNS FOR CORN ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Corn	Bushel	75.0	$1.10	$82.50	80.0	$1.10	$88.00	90.0	$1.10	$99.00	70.0	$1.10	$77.00	85.0	$1.10	$93.50
Expenses:																
Seed	Bushel	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02
Fertilizer																
At Planting																
(6-24-24)	Cwt.	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13
Side or Top Dress	Cwt.	1.2	6.10	7.32	1.3	6.10	7.93	1.4	6.10	8.54	2.5	3.80[a]	9.50	1.4	6.10	8.54
Pest Control																
Weeds	Acre	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00
Insects	Acre	1.0	1.00	1.00	1.0	1.00	1.00	1.0	1.00	1.00	1.0	1.00	1.00	1.0	1.00	1.00
Machine Costs																
Variable																
(Preharvest)	Acre	1.0	7.09	7.09	1.0	7.22	7.22	1.0	7.50	7.50	1.0	6.91	6.91	1.0	7.36	7.36
Fixed	Acre	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45
Variable																
(Harvest)	Acre + .05/bu	1.0	8.75	8.75	1.0	9.00	9.00	1.0	9.50	9.50	1.0	8.50	8.50	1.0	9.25	9.25
Fixed	Acre	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85
Interest on																
Operating Capital	Acre	1.0	0.81	0.81	1.0	0.83	0.83	1.0	0.85	0.85	1.0	0.88	0.88	1.0	0.85	0.85
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Cost (Drying)	Bushel	75.0	0.04	6.00	80.0	0.04	3.20	90.0	0.04	3.60	70.0	0.04	2.80	85.0	0.04	3.40
Total Cost Per Acre*				$49.02			$50.23			$52.04			$50.64			$51.45
Net Returns to Land, Labor, and Mgmt.				$33.48			$37.77			$46.96			$26.36			$42.05

*All costs except land charge.

[a]33% nitrogen.

APPENDIX TABLE VIII

CORN FOR SILAGE: ESTIMATED COSTS AND RETURNS FOR CORN ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Corn	Ton	14.0	$8.00	$112.00	14.5	$8.00	$116.00	16.0	$8.00	$128.00	13.0	$8.00	$104.00	15.0	$8.00	$120.00
Expenses:																
Seed	Bushel	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02	0.2	10.10	2.02
Fertilizer																
At Planting (6-24-24)	Cwt.	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13	2.5	3.65	9.13
Side or Top Dress	Cwt.	1.2	6.10	7.32	1.4	6.10	8.54	1.4	6.10	10.37	2.7	3.80[a]	10.26	1.5	6.10	9.15
Pest Control																
Weeds	Acre	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00	1.0	5.00	5.00
Insects	Acre	1.0	1.25	1.25	1.0	1.25	1.25	1.0	1.25	1.25	1.0	1.25	1.25	1.0	1.25	1.25
Machine Costs																
Variable (Preharvest)	Acre	1.0	8.09	8.09	1.0	8.34	8.34	1.0	8.69	8.69	1.0	7.84	7.84	1.0	8.62	8.62
Fixed	Acre	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.45	1.45
Variable (Harvest)	Acre	1.0	13.38	13.38	1.0	14.78	14.78	1.0	18.54	18.54	1.0	10.97	10.97	1.0	16.15	16.15
Fixed	Acre	1.0	0.93	0.93	1.0	0.93	0.93	1.0	0.93	0.93	1.0	0.93	0.93	1.0	0.93	0.93
Interest on Operating Capital	Acre	1.0	0.82	0.82	1.0	0.86	0.86	1.0	0.91	0.91	1.0	0.91	0.91	1.0	0.87	0.87
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost Per Acre*				$51.99			$54.90			$60.89			$52.36			$57.17
Net Returns to Land, Labor, and Mgmt.				$60.01			$61.10			$67.11			$51.64			$62.83

*All costs except land charge.

[a] 33% nitrogen.

APPENDIX TABLE IX

BARLEY: ESTIMATED COSTS AND RETURNS FOR BARLEY ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Barley	Bushel	37.0	$0.85	$31.45	37.0	$0.85	$31.45	42.0	$0.85	$35.70	35.0	$0.85	$29.75	40.0	$0.85	$34.00
Expenses:		48.0	0.24	11.52	48.0	0.24	11.52	52.0	0.24	12.48	45.0	0.24	10.80	50.0	0.24	12.00
Seed	Bushel	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75
Fertilizer																
At Planting																
(15-15-15)	Cwt.	2.4	3.55	8.52	2.4	3.55	8.52	2.3	3.55	8.17	2.4	3.55	8.52	2.3	3.55	8.17
Machine Costs																
Variable																
(Preharvest)	Acre	1.0	1.31	1.31	1.0	1.31	1.31	1.0	1.45	1.45	1.0	1.27	1.27	1.0	1.37	1.37
Fixed	Acre	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51
Variable																
(Harvest)	Acre	1.0	6.72	6.72	1.0	6.72	6.72	1.0	6.92	6.92	1.0	6.65	6.65	1.0	6.87	6.87
Fixed	Acre	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68
Interest on																
Operating Capital	Acre	1.0	0.39	0.39	1.0	0.39	0.39	1.0	0.38	0.38	1.0	0.39	0.39	1.0	0.38	0.38
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Cost	Acre	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85
Total Cost Per Acre*				$25.33			$25.33			$25.31			$25.22			$25.18
Net Returns to Land, Labor, and Mgmt.				$17.64			$17.64			$22.87			$15.33			$20.82

*All costs except land charge.

APPENDIX TABLE X

MILO FOR GRAIN: ESTIMATED COSTS AND RETURNS FOR MILO ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Milo	Bushel	60.0	$1.00	$60.00	62.0	$1.00	$62.00	75.0	$1.00	$75.00	60.0	$1.00	$60.00	75.0	$1.00	$75.00
Expenses:																
Seed	Pound	4.7	0.12	0.56	4.6	0.12	0.55	4.4	0.12	0.53	4.8	0.12	0.58	4.4	0.12	0.53
Fertilizer																
At Planting (15-15-15)	Cwt.	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65
Side or Top Dress (82%)	Cwt.	0.75	6.10	4.58	0.82	6.10	5.00	0.98	6.10	5.98	1.4	3.80[a]	5.32	0.98	6.10	5.98
Pest Control																
Insects	Acre	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70
Machine Costs																
Variable (Preharvest)	Acre	1.0	9.86	9.86	1.0	9.86	9.86	1.0	10.66	10.66	1.0	9.86	9.86	1.0	10.66	10.66
Fixed	Acre	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20
Variable (Harvest)	Acre	1.0	10.71	10.71	1.0	10.81	10.81	1.0	12.06	12.06	1.0	10.71	10.71	1.0	12.06	12.06
Fixed	Acre	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72
Interest on Operating Capital	Acre	1.0	0.57	0.57	1.0	0.59	0.59	1.0	0.61	0.61	1.0	0.60	0.60	1.0	0.61	0.61
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Cost (Drying)	Bushel	60.0	0.08	4.80	60.0	0.08	4.80	60.0	0.08	4.80	60.0	0.08	4.80	60.0	0.08	4.80
Total Cost Per Acre*				$46.95			$47.48			$50.51			$47.74			$50.51
Net Returns to Land, Labor, and Mgmt.				$13.05			$14.52			$24.49			$12.26			$24.49

*All costs except land charge.

[a]33% nitrogen.

APPENDIX TABLE XI

MILO-SILAGE: ESTIMATED COSTS AND RETURNS FOR MILO ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Milo	Ton	14.0	$7.00	$98.00	14.0	$7.00	$98.00	16.0	$7.00	$112.00	13.5	$7.00	$94.50	15.0	$7.00	$105.00
Expenses:																
Seed	Pound	4.7	0.12	0.56	4.6	0.12	0.55	4.4	0.12	0.53	4.8	0.12	0.58	4.4	0.12	0.53
Fertilizer																
At Planting (15-15-15)	Cwt.	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65	3.0	3.55	10.65
Side or Top Dress (82%)	Cwt.	0.75	6.10	4.58	0.82	6.10	5.00	0.98	6.10	5.98	1.4	3.80[a]	5.32	0.98	6.10	5.98
Pest Control																
Insects	Acre	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70	1.0	0.70	0.70
Machine Costs																
Variable (Preharvest)	Acre	1.0	9.86	9.86	1.0	9.86	9.86	1.0	10.66	10.66	1.0	9.86	9.86	1.0	10.66	10.66
Fixed	Acre	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20	1.0	1.20	1.20
Variable (Harvest)	Acre	1.0	13.38	13.38	1.0	14.78	14.78	1.0	18.54	18.54	1.0	10.97	10.97	1.0	16.15	16.15
Fixed	Acre	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72	1.0	0.72	0.72
Interest on Operating Capital	Acre	1.0	0.57	0.57	1.0	0.59	0.59	1.0	0.61	0.61	1.0	0.60	0.60	1.0	0.61	0.61
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Cost	Acre	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85
Total Cost Per Acre*				$45.67			$47.50			$53.04			$44.05			$50.65
Net Returns to Land, Labor, and Mgmt.				$50.33			$50.50			$58.96			$50.45			$54.35

*All costs except land charge.

[a]33% nitrogen.

APPENDIX TABLE XII

WHEAT-WINTER: ESTIMATED COSTS AND RETURNS FOR WHEAT ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Wheat	Bushel	40.0	$1.75	$70.00	40.0	$1.75	$70.00	45.0	$1.75	$78.75	37.0	$1.75	$64.75	42.0	$1.75	$73.50
	Straw	50.0	0.24	12.00	50.0	0.24	12.00	50.0	0.24	12.00	48.0	0.24	11.52	50.0	0.24	12.00
Expenses:																
Seed	Bushel	1.5	3.20	4.80	1.5	3.20	4.80	1.5	3.20	4.80	1.5	3.20	4.80	1.5	3.20	4.80
Fertilizer																
At Planting (15-15-15)	Cwt.	1.75	3.55	6.21	1.75	3.55	6.21	1.8	3.55	6.39	1.75	3.55	6.21	1.75	3.55	6.21
Side or Top Dress (33%)	Cwt.	1.3	3.80	4.94	1.3	3.80	4.94	1.4	3.80	5.32	1.3	3.80	4.94	1.3	3.80	4.94
Machine Costs																
Variable (Preharvest)	Acre	1.0	1.45	1.45	1.0	1.45	1.45	1.0	1.63	1.63	1.0	1.37	1.37	1.0	1.54	1.54
Fixed	Acre	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51
Variable (Harvest)	Acre	1.0	6.92	6.92	1.0	6.92	6.92	1.0	7.03	7.03	1.0	6.87	6.87	1.0	6.97	6.97
Fixed	Acre	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68	1.0	1.68	1.68
Interest on Operating Capital	Acre	1.0	0.59	0.59	1.0	0.59	0.59	1.0	0.61	0.61	1.0	0.59	0.59	1.0	0.59	0.59
Storage	Bushel	40.0	0.08	3.20	40.0	0.08	3.20	45.0	0.08	3.60	37.0	3.60	2.96	42.0	3.60	3.36
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Cost	Acre	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85
Total Cost Per Acre*				$34.75			$34.75			$36.02			$34.38			$35.05
Net Returns to Land, Labor, and Mgmt.				$47.25			$47.25			$54.73			$41.89			$50.45

*All costs except land charge.

APPENDIX TABLE XIII

OATS FOR GRAIN: ESTIMATED COSTS AND RETURNS FOR OATS ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Oats	Bushel	40.0	$0.70	$28.00	40.0	$0.70	$28.00	45.0	$0.70	$31.50	38.0	$0.70	$26.60	40.0	$0.70	$28.00
	Straw	30.0	0.24	7.20	30.0	0.24	7.20	35.0	0.24	8.40	30.0	0.24	7.20	35.0	0.24	8.40
Expenses:																
Seed	Bushel	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75
Fertilizer																
At Planting (15-15-15)	Cwt.	2.9	3.55	10.30	2.9	3.55	10.30	3.1	3.55	11.01	2.9	3.55	10.30	3.1	3.55	11.01
Machine Costs																
Variable (Preharvest)	Acre	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.43	1.43	1.0	1.10	1.10	1.0	1.15	1.15
Fixed	Acre	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51
Variable (Harvest)	Acre	1.0	5.24	5.24	1.0	5.24	5.24	1.0	5.37	5.37	1.0	5.15	5.15	1.0	5.24	5.24
Fixed	Acre	1.0	1.57	1.57	1.0	1.57	1.57	1.0	1.57	1.57	1.0	1.57	1.57	1.0	1.57	1.57
Interest on Operating Capital	Acre	1.0	0.46	0.46	1.0	0.46	0.46	1.0	0.48	0.48	1.0	0.46	0.46	1.0	0.48	0.48
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost per Acre*				$24.58			$24.58			$25.72			$24.44			$25.31
Net Returns to Land, Labor, and Mgmt.				$10.62			$10.62			$14.18			$ 9.36			$11.09

*All costs except land charge.

APPENDIX TABLE XIV

OATS-HAY FOR GRAIN: ESTIMATED COSTS AND RETURNS FOR OATS-HAY ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Oats-Hay	Ton	3.0	$16.50	$49.50	3.0	$16.50	$49.50	3.4	$16.50	$56.10	2.8	$16.50	$46.20	3.4	$16.50	$56.10
Expenses:																
Seed	Bushel	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75	1.4	1.25	1.75
Fertilizer																
At Planting (15-15-15)	Cwt.	2.9	3.55	10.30	2.9	3.55	10.30	3.1	3.55	11.01	2.9	3.55	10.30	3.1	3.55	11.01
Machine Costs																
Variable (Preharvest)	Acre	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.43	1.43	1.0	1.10	1.10	1.0	1.43	1.43
Fixed	Acre	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51	1.0	1.51	1.51
Variable (Harvest)	Acre	1.0	5.03	5.03	1.0	5.03	5.03	1.0	5.27	5.27	1.0	4.96	4.96	1.0	5.27	5.27
Fixed	Acre	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35
Interest on Operating Capital	Acre	1.0	0.46	0.46	1.0	0.46	0.46	1.0	0.48	0.48	1.0	0.46	0.46	1.0	0.48	0.48
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost Per Acre*				$24.15			$24.15			$25.40			$24.03			$25.40
Net Returns to Land, Labor, and Mgmt.				$25.35			$25.35			$30.70			$22.17			$30.70

*All costs except land charge.

APPENDIX TABLE XV

ALFALFA: ESTIMATED COSTS AND RETURNS FOR ALFALFA HAY ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Alfalfa Hay	Ton	3.8	$24.00	$91.20	3.8	$24.00	$91.20	4.0	$24.00	$96.00	3.5	$24.00	$84.00	4.0	$24.00	$96.00
Expenses:																
Seed	Pound	1.6	0.65	1.04	1.6	0.65	1.04	1.6	0.65	1.04	1.6	0.65	1.04	1.6	0.65	1.04
Fertilizer																
At Planting																
(6-24-24)	Cwt.	1.7	3.65	6.21	1.8	3.65	6.57	1.9	3.65	6.94	1.7	3.65	6.21	1.9	3.65	6.94
Side or Top Dress	Cwt.	1.2	6.10	7.32	1.3	6.10	7.93	1.4	6.10	8.54	1.2	6.10	7.32	1.4	6.10	8.54
Pest Control																
Insects	Acre	1.0	3.50	3.50	1.0	3.50	3.50	1.0	3.50	3.50	1.0	3.50	3.50	1.0	3.50	3.50
Machine Costs																
Variable																
(Preharvest)	Acre	1.0	5.85	5.85	1.0	5.63	5.63	1.0	6.25	6.25	1.0	5.85	5.85	1.0	6.25	6.25
Fixed	Acre	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15
Variable																
(Harvest)	Acre	1.0	10.15	10.15	1.0	10.15	10.15	1.0	10.41	10.41	1.0	9.90	9.90	1.0	10.41	10.41
Fixed	Acre	1.0	0.96	0.96	1.0	0.96	0.96	1.0	0.96	0.96	1.0	0.96	0.96	1.0	0.96	0.96
Interest on																
Operating Capital	Acre	1.0	0.62	0.62	1.0	0.65	0.65	1.0	0.68	0.68	1.0	0.62	0.62	1.0	0.68	0.68
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost Per Acre*				$39.40			$40.18			$42.07			$39.15			$42.07
Net Returns to Land, Labor, and Mgmt.				$51.80			$51.02			$53.93			$44.85			$53.93

*All costs except land charges.

APPENDIX TABLE XVI

CLOVER HAY AND SEED: ESTIMATED COSTS AND RETURNS FOR CLOVER ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Clover Hay	Ton	2.5	$20.00	$50.00	2.5	$20.00	$50.00	3.0	$20.00	$60.00	2.3	$20.00	$46.00	2.8	$20.00	$56.00
Clover Seed	Pound	60.0	0.30	18.00	60.0	0.30	18.00	65.0	0.30	19.50	57.0	0.30	17.10	65.0	0.30	19.50
Expenses:																
Seed	Pound	10.0	0.30	3.00	10.0	0.30	3.00	10.0	0.30	3.00	10.0	0.30	3.00	10.0	0.30	3.00
Fertilizer																
At Planting (15-15-15)	Cwt.	1.9	3.55	6.75	1.9	3.55	6.75	2.0	3.55	7.10	1.9	3.55	6.75	2.0	3.55	7.10
Machine Costs																
Variable (Preharvest)	Acre	1.0	5.63	5.63	1.0	5.63	5.63	1.0	5.83	5.83	1.0	5.63	5.63	1.0	5.89	5.89
Fixed	Acre	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35	1.0	1.35	1.35
Variable (Harvest)	Acre	1.0	13.42	13.42	1.0	13.42	13.42	1.0	13.97	13.97	1.0	13.22	13.22	1.0	13.77	13.77
Fixed	Acre	1.0	1.26	1.26	1.0	1.26	1.26	1.0	1.26	1.26	1.0	1.26	1.26	1.0	1.26	1.26
Interest on Operating Capital	Acre	1.0	0.37	0.37	1.0	0.37	0.37	1.0	0.38	0.38	1.0	0.37	0.37	1.0	0.38	0.38
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Other Costs (Cleaning)	Pound	85.0	0.01	0.85	85.0	0.01	0.85	95.0	0.01	0.95	80.0	0.01	0.80	95.0	0.01	0.95
Total Cost Per Acre*				$35.23			$35.23			$36.44			$34.98			$36.30
Net Returns to Land, Labor, and Mgmt.				$32.77			$32.77			$43.06			$28.12			$39.20

*All costs except land charge.

APPENDIX TABLE XVII

LEGUME GRASS HAY: ESTIMATED COSTS AND RETURNS FOR LEGUME GRASS ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Legume Grass Hay	Ton	2.5	$20.00	$50.00	2.5	$20.00	$50.00	3.0	$20.00	$60.00	2.3	$20.00	$46.00	2.8	$20.00	$56.00
Expenses:																
Seed	Lbs.	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70
Fertilizer																
At Planting (15-15-15)	Cwt.	1.9	3.55	6.75	1.9	3.55	6.75	2.0	3.55	7.10	1.9	3.55	6.75	2.0	3.55	7.10
Machine Costs																
Variable (Preharvest)	Acre	1.0	5.43	5.43	1.0	5.43	5.43	1.0	5.63	5.63	1.0	5.43	5.43	1.0	5.69	5.69
Fixed	Acre	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15	1.0	1.15	1.15
Variable (Harvest)	Acre	1.0	7.76	7.76	1.0	7.76	7.76	1.0	8.31	8.31	1.0	7.56	7.56	1.0	8.11	8.11
Fixed	Acre	1.0	0.92	0.92	1.0	0.92	0.92	1.0	0.92	0.92	1.0	0.92	0.92	1.0	0.92	0.92
Interest on Operating Capital	Acre	1.0	0.33	0.33	1.0	0.33	0.33	1.0	0.34	0.34	1.0	0.33	0.33	1.0	0.34	0.34
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost Per Acre*				$26.64			$26.64			$27.75			$26.44			$27.61
Net Returns to Land, Labor, and Mgmt.				$23.36			$23.36			$32.25			$19.56			$28.39

*All costs except land charge.

APPENDIX TABLE XVIII

ROTATION PASTURE-LEGUME GRASS MIXTURE: ESTIMATED COSTS AND RETURNS FOR LEGUME GRASS ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Legume Grass	Ton-Hay Equiv.	2.8	$11.00	$30.80	2.8	$11.00	$30.80	3.0	$11.00	$33.00	2.5	$11.00	$27.50	3.0	$11.00	$33.00
Expenses:																
Seed	Lbs.	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70	8.5	0.20	1.70
Fertilizer																
At Planting (15-15-15)	Cwt.	1.9	3.55	6.75	1.9	3.55	6.75	1.9	3.55	6.75	1.9	3.55	6.75	1.9	3.55	6.75
Machine Costs																
Variable (Preharvest)	Acre	1.0	1.38	1.38	1.0	1.38	1.38	1.0	1.38	1.38	1.0	1.38	1.38	1.0	1.38	1.38
Fixed	Acre	1.0	0.67	0.67	1.0	0.67	0.67	1.0	0.67	0.67	1.0	0.67	0.67	1.0	0.67	0.67
Interest on Operating Capital	Acre	1.0	0.23	0.23	1.0	0.23	0.23	1.0	0.23	0.23	1.0	0.23	0.23	1.0	0.23	0.23
Total Cost Per Acre*				$10.73			$10.73			$10.73			$10.73			$10.73
Net Returns to Land, Labor, and Mgmt.				$20.07			$20.07			$22.27			$16.77			$22.77

*All costs except land charge.

APPENDIX TABLE XIX

SUDAN GRASS: ESTIMATED COSTS AND RETURNS FOR SUDAN GRASS ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Sudan Grass	Ton-Hay Equiv.	3.0	$11.00	$33.00	3.0	$11.00	$33.00	3.5	$11.00	$38.50	3.0	$11.00	$33.00	3.5	$11.00	$38.50
Expenses:																
Seed	Lbs.	28.0	0.12	3.36	28.0	0.12	3.36	28.0	0.12	3.36	28.0	0.12	3.36	28.0	0.21	3.36
Fertilizer																
At Planting (15-15-15)	Cwt.	2.9	3.55	10.30	2.9	3.55	10.30	3.2	3.55	11.36	2.9	3.55	10.30	3.2	3.55	11.36
Machine Costs																
Variable (Preharvest)	Acre	1.0	0.65	0.65	1.0	0.65	0.65	1.0	0.65	0.65	1.0	0.65	0.65	1.0	0.65	0.65
Fixed	Acre	1.0	2.30	2.30	1.0	2.30	2.30	1.0	2.30	2.30	1.0	2.30	2.30	1.0	2.30	2.30
Interest on Operating Capital	Acre	1.0	0.49	0.49	1.0	0.49	0.49	1.0	0.49	0.49	1.0	0.49	0.49	1.0	0.49	0.49
Limestone	Ton	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60	0.4	6.50	2.60
Total Cost Per Acre*				$19.70			$19.70			$20.76			$19.70			$20.76
Net Returns to Land, Labor, and Mgmt.				$13.30			$13.30			$17.74			$13.30			$17.74

*All costs except land charge.

APPENDIX TABLE XX

PERMANENT PASTURE: ESTIMATED COSTS AND RETURNS FOR PASTURE ON UNTERRACED UPLAND CROPLAND, TERRACED UPLAND CROPLAND, AND BOTTOMLAND FOR AREA 1 AND AREA 2, FRANKLIN COUNTY, 1970-1975

		Area 1									Area 2					
		Unterraced Upland Cropland			Terraced Upland Cropland			Bottomland			Upland Cropland			Bottomland		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount	Quantity	Price	Amount
Income:																
Perm. Pasture	Ton-Hay Equiv.	1.8	$7.00	$12.60	1.8	$7.00	$12.60	2.2	$7.00	$15.40	1.6	$7.00	$11.20	2.0	$7.00	$14.00
Expenses:																
Fertilizer																
At Planting (15-15-15)	Cwt.	1.3	3.55	4.62	1.3	3.55	4.62	1.3	3.55	4.62	1.3	3.55	4.62	1.3	3.55	4.62
Machine Costs																
Variable (Preharvest)	Acre	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85	1.0	0.85	0.85
Fixed	Acre	1.0	0.54	0.54	1.0	0.54	0.54	1.0	0.54	0.54	1.0	0.54	0.54	1.0	0.54	0.54
Interest on Operating Capital	Acre	1.0	0.14	0.14	1.0	0.14	0.14	1.0	0.14	0.14	1.0	0.14	0.14	1.0	0.14	0.14
Total Cost Per Acre*				$6.15			$6.15			$6.15			$6.15			$6.15
Net Returns to Land, Labor, and Mgmt.				$6.45			$6.45			$9.25			$5.05			$7.85

*All costs except land charge.

APPENDIX TABLE XXI

MONTHLY LABOR REQUIREMENTS FOR LIVESTOCK ENTERPRISES, PER UNIT OF PRODUCTION[a]

Enterprise	Size	Total Hours	Hours Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Dairy Cow														
Non-Confined	10-59	80.00	8.00	8.00	8.00	8.00	5.60	5.60	5.60	5.60	5.60	5.60	6.40	8.00
	60 up	72.00	7.20	7.20	7.20	7.20	5.04	5.04	5.04	5.04	5.04	5.04	5.76	7.20
Dry Lot	10-59	72.00	7.20	7.20	7.20	7.20	5.04	5.04	5.04	5.04	5.04	5.04	5.76	7.20
	60 up	65.00	6.50	6.50	6.50	6.50	4.55	4.55	4.55	4.55	4.55	4.55	5.20	6.50
Sow and	1-15	60.00	5.40	6.00	6.00	4.80	4.20	3.60	4.80	6.00	4.80	4.80	4.80	4.80
Two Litters-	16-35	42.00	3.80	4.30	4.30	3.30	2.97	2.53	3.30	4.30	3.30	3.30	3.30	3.30
Market Hogs	36-60	30.00	2.70	3.00	3.00	2.40	1.80	1.80	2.40	3.00	2.70	2.40	2.40	2.40
Sow and	1-15	30.00	2.00	5.10	2.70	2.10	1.80	1.30	1.80	5.00	2.60	2.20	1.40	2.00
Two Litters-	16-35	30.00	2.00	5.10	2.70	2.10	1.80	1.30	1.80	5.00	2.60	2.20	1.40	2.00
Feeder Pigs	36 up	30.00	2.00	5.10	2.70	2.10	1.80	1.30	1.80	5.00	2.60	2.20	1.40	2.00
Beef Cow	1-15	8.00	0.96	1.04	1.04	0.96	0.48	0.24	0.24	0.24	0.24	0.72	0.88	0.96
and Calf	16-35	8.00	0.96	1.04	1.04	0.96	0.48	0.24	0.24	0.24	0.24	0.72	0.88	0.96
	36-60	8.00	0.96	1.04	1.04	0.96	0.48	0.24	0.24	0.24	0.24	0.72	0.88	0.96
	61 up	8.00	0.96	1.04	1.04	0.96	0.48	0.24	0.24	0.24	0.24	0.72	0.88	0.96

[a]Adapted from Justus, Fred E. Jr., and Ronald D. Alexander. Cost Minimizing Plans for Various Types of Farms in Northeast Missouri. University of Missouri, Agricultural Experiment Station Research Bulletin 879, Columbia, January, 1965.

APPENDIX TABLE XXII

FEEDER PIGS: ESTIMATED COSTS AND RETURNS FOR A SOW AND TWO LITTERS OF PIGS

(Fixed expenses were computed on a 20-sow unit)

Item	Unit	Quantity	Price (Dollars)	Amount (Dollars)
INCOME				
Feeder Pigs [a]	head	14.0	$15.00	$210.00
Cull Sow [b] (.5 of a sow)	cwt.	2.0	13.00	26.00
			Total --	$236.00
COSTS				
a. Variable				
Corn [c]	bu.	55.0	$ 1.10	$ 60.50
Supplement [d] (includes mineral)	cwt.	4.4	5.00	22.00
Creep Feed (20# per pig)	cwt.	2.9	5.50	15.95
Pasture (1/4 acre per sow)	acre	0.25	11.00	2.75
Marketing Pigs	head	14.0	0.50	7.00
Marketing Sow	head	0.5	2.00	1.00
Vet & medicine [e]				11.45
Electricity	sow	1.0	1.50	1.50
Truck	head	14.0	0.25	3.50
Tractor	hour	2.0	0.50	1.00
Corn Storage	bu.	55.0	0.10	5.50
Total variable expenses --				$132.15
Net income above variable expenses --				$103.85

APPENDIX TABLE XXIII

MARKET HOGS: ESTIMATED COSTS AND RETURNS FOR A SOW AND TWO LITTERS OF PIGS

(Fixed expenses were computed on a 20-sow unit)

Item	Unit	Quantity	Price (Dollars)	Amount (Dollars)
INCOME				
Market Hogs[a]				
14 head @ 220#	cwt.	30.8	$16.00	$492.80
Cull Sow[b]				
.5 of a sow	cwt.	2.0	13.00	26.00
			Total --	$518.80
COSTS				
a. Variable				
Corn[c]	bushel	183.0	1.10	201.30
Supplement[d]				
(includes mineral)	cwt.	18.4	5.00	92.00
Creep Feed				
(20# per pig)	cwt.	2.9	5.50	15.95
Pasture				
(1/4 acre per sow)	acre	0.25	11.00	2.75
Marketing	head	14.5	.75	10.87
Vet & medicine[e]				15.07
Electricity	sow	1.0	1.50	1.50
Truck	cwt.	32.8	.40	13.12
Tractor (operating)	hour	4.0	.50	2.00
Corn Storage	bushel	183.0	.10	18.30
		Total variable expenses	--	$372.86
	Net income above	variable expenses	--	$145.94

APPENDIX TABLE XXIII (Continued)

Item	Unit	Quantity	Price (Dollars)	Amount (Dollars)
b. Fixed				
Boar (breeding charge)[f]	sow	2.0	$ 2.00	$ 4.00
Reprs. and depr. on bldgs. & equipment[g]	sow	1.0	7.50	7.50
Tractor	hour	4.0	0.50	2.00
Reprs. and depr. on fences[h]				3.90
Interest[i]				12.60
Total fixed expenses --				$ 30.00
Total variable and fixed expenses --				$402.86
Net return to land, labor, and management --				$115.94

[a]Assumes 1.8 litters per sow with average litter size of 8 pigs.

[b]Assumes each sow will produce 4 litters and then be replaced.

[c]Assumes 50 bushels of corn for the sow and her replacement and 9.5 bushels for each pig, from weaning to market.

[d]Assumes 440 pounds of supplement for sow and her replacement, plus 100 pounds per pig. Supplement mixtures are given in Publication 391, "More Money from Hogs."

[e]Assumes the same vaccination program as outlined for feeder pigs plus 25 cents veterinary fee per market hog.

[f]See Feeder Pig budget.

[g]Assumes the same depreciation and repair of buildings and equipment as outlined in Feeder Pig budget plus $1.00 per sow for additional feeders.

[h]Fence costs were computed for 19 acres. Five acres for sows and two 7-acre fields (one for each litter) for market hogs. Costs were based on 433 rods of fence.

[i]Six per cent on $210.

APPENDIX TABLE XXIV

BEEF COW AND CALF: ESTIMATED COSTS AND RETURNS

Item	Unit	Quantity	Price (Dollars)	Amount (Dollars)
INCOME				
Feeder Calves[a]				
(475# @ $24.50)	head	0.733	$116.37	$ 85.30
Cull Cows				
(900# @ $15)	head	0.1667	135.00	22.50
			Total --	$107.80
COSTS				
a. Variable				
Pasture[b]	ton H.E.	3.5	$ 11.00	$ 38.50
Hay[c]	ton H.E.	1.17	20.00	23.40
Mineral & Salt	head	1.1667	0.75	0.88
Vet. & Medicine	head	1.1667	2.50	2.92
Mktg. & Auction Fees	head	0.90	2.50	2.25
Tractor				
(operating expenses)[d]	hour	1.333	0.50	0.67
Trucking Expense	head	0.90	1.00	0.90
			Total variable expenses --	$ 69.52
			Net income above variable expenses --	$ 38.28

APPENDIX TABLE XXIV (Continued)

Item	Unit	Quantity	Price (Dollars)	Amount (Dollars)
b. Fixed				
Depr. & reprs. on bldgs. & equipment[e]	head	1.0	$ 2.00	$ 2.00
Depreciation on bull[f]				1.67
Tractor[g]	hour	1.333	.50	.67
Depr. & repr. of fence[h]				2.76
Interest on Investment[i]				16.92
Total fixed expenses --				$ 24.02
Total variable and fixed expenses --				$ 93.54
Net return to land, labor, and management--				$ 14.26

[a]Assumes a 90 per cent calf crop and a 16 2/3 per cent replacement rate. Cows calve in January and February.

[b]Value of pasture roughage produced.

[c]Hay will be fed from November 15 to April 1 (183 days) at the rate of 15 pounds per day per animal unit. Assumes there will be enough clover to eliminate the necessity of feeding supplement and cows will have access to corn fields and other roughage.

[d]Tractor operating expenses include gas, oil, grease, antifreeze, etc. Tractor is used in the feeding operation.

[e]Assumes $1 depreciation on buildings plus $1 building repair per cow.

[f]Assumes a $50 bull replaced every 3 years and sold for $300.

[g]Assumes $.50 depreciation and repair per hour of use.

[h]Fence repairs and depreciation were computed on the basis of 12 cents annual cost per rod. Assumes 4 strands of barbed wire and posts spaced 10 feet apart. Total cost was $1.50 per rod, excluding labor.

[i]Six per cent x 282, the investment in livestock, buildings, and equipment.

APPENDIX TABLE XXV

ESTIMATED COSTS AND RETURNS FOR RESPECTIVE DAIRY ENTERPRISES, FLUID MARKET

Forage System	Pasture Feeding		Dry-Lot Feeding		Dairy Replacement Heifer	
Detail of Gross Receipts -Cow Culling Rate, 25% -Cow Death Loss, 5% -Calf Crop - 90% of cows -Calves saved by replacements, 25%	-12,000 lbs. Milk @ 4.50	$540.00	13,500 lbs. Milk @ 4.50	$607.50	Bred Heifer	$275.00
	-Cull cow: 1,200 lbs. x 95% x 25% or 285 lbs. @ $13.50	38.47	-Cull cow: 1,200 lbs. x 95% x 75%, or 285 lbs. @ $13.50	38.47		
	-Calf $30 x 90% x 75%	20.25	-Calf $30 x 90% x 75%	20.25	Less death loss, half of total enterprise cost $118.25	7.10
Gross Receipts Per Enterprise Unit		$598.72		$666.22		$267.90
Replacement Heifer: feed and non-feed costs, x 25%	$196.50 x 25%	49.13	$196.50 x 25%	49.13	Day-old calf	40.00
Grain: Dairy mix @ $2.80[a]	4,600 lbs. @ $2.80	128.80	5,400 lbs. @ $2.80	151.20	Milk, 400 lbs. @ $4.25	17.00
					Starter, 250 lbs. @ $5.50	13.75
Hay Equivalent:[b]						
-In Silage and/or hay @ $24.00 per ton	4.0 tons @ $24.00	96.00	4.5 tons @ $24.00	108.00	Grain Mix, 2,000 lbs. @ $2.80	56.00
-In pasture @ $11.00 per ton	4.0 tons @ $11.00	44.00	1.5 tons @ $11.00	16.50	Hay equiv.:	
					-Silage and/or hay @ $20.00	59.07
					-Pasture 3 T. @ $11.00	33.00
Total Feed Costs (Cow Only)		$268.80		$275.70		$178.82
Breeding Charge		8.00		9.00		9.00
Veterinary & Drugs		11.00		12.00		6.00
Testing, Utilities, Supplies	$5, $8, $7	20.00	$5, $9, $7	21.00		
Miscellaneous expenses, 1.0% of gross receipts	$628.72 x 1.0%	6.29	$701.22 x 1.0%	7.01		2.68
Total Other Variable Costs		$45.29		$49.01		$17.68
Interest on Average Investment	6.0% of 870	5.32	6.0% of 960	5.76		
Total All Variable Costs		$368.54		$379.60		$236.50
Return to Land, Labor, and Mgmt.		$230.18		$286.62		

[a]Dairy mix of hay equivalent poundages were calculated on the basis of information provided by Professor Fred H. Meinershagen of the Department of Dairy Husbandry.

[b]Silage may be substituted for hay up to two-thirds of the hay requirement for cattle on pasture. In the case of cattle on dry lot, silage may substitute for hay up to the total requirement needed. Figure three pounds of silage equal to one pound of hay.

APPENDIX XXVI

ESTIMATED COSTS AND RETURNS FOR LIVESTOCK ENTERPRISES

Enterprise	Gross Income	Specified Expenses	Net Returns
Feeder Pig (Sow and Two Litters)	$236.00	$150.10	$ 85.90
Market Hog (Sow and Two Litters)	518.80	402.86	115.94
Beef Cow	107.80	93.54	14.26
Dairy: Pasture Fed	598.72	368.54	230.18
Dairy: Dry-Lot	666.22	379.60	286.62